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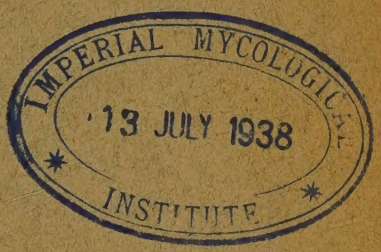

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VARIETY TESTS OF CABBAGE

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Of the Horticulture Section, Bureau of Plant Industry

FOURTEEN PLATES

The cabbage, *Brassica oleracea* var, *capitata* Hort., is one of the most successful among semi-temperate vegetable immigrants in the Philippines. In the near future, it may become one of the leading and perhaps, the most popular vegetable here. The first introduction of this vegetable into the Islands is not definitely known. While its early successful cultures were confined at medium and high altitudes like Baguio and Trinidad Valley, Mountain Province (1933), a few trials (1924) in the lowland also showed great possibilities. As early as 1910, cabbage was successfully grown under a semi-commercial scale in the Batac Rural High School, Batac, Ilocos Norte. In Manila and its suburbs, cabbage has been under cultivation for long under Chinese gardeners although in a limited scale.

The present work was undertaken because of the demand for more information about cabbage culture in the lowlands. At the same time it was deemed necessary to find varieties that are best adapted to conditions in the plains. The discovery of the best varieties for lowland cultures—for early and late planting—would certainly be a very valuable information to vegetable growers and truckers.

The work was first undertaken at the defunct Alabang Rice Station, Rizal; then the work was transferred to the Central Experiment Station, Manila; to the Lipa Coffee–Citrus Station,

Lipa, Batangas Province; and to the Los Baños Economic Garden, Los Baños, Laguna. The study was started in November, 1932 and completed in March, 1937.

MATERIALS AND METHODS

Because of the fact that cabbage seed is not yet commercially produced in the Islands, the different varieties used in this study were imported from the United States, England, and China. Table 1 gives a list of the varieties tested, and the seedhouse and country of origin.

TABLE 1.—*Showing the names of the varieties tested and the country of origin*

Variety name	Seedhouse or company	Country of origin
Allhead Early	W. Atlee Burpee Co.,Pa., Penn.	U. S. A.
Allhead Select	do	Do.
All Seasons	do	Do.
Autumn King	Peter Henderson & Co., N. Y.	Do.
Charleston Wakefield	do	Do.
Copenhagen Market	do	Do.
Danish Ballhead	Local Seed store	Do.
Danish Roundhead	W. Atlee Burpee Co., Pa., Penn.	Do.
Early Dwarf Flat Dutch	do	Do.
Early Jersey Wakefield	do	Do.
Early Krop	Peter Henderson & Co., N. Y.	Do.
Early Market	do	Do.
Early Stonehead	W. Atlee Burpee Co., Pa., Penn.	Do.
Early Summer	Peter Henderson & Co., N. Y.	Do.
Early Winnigstadt	W. Atlee Burpee Co., Pa., Penn.	Do.
Entrkhuizen Glory	do	Do.
Golden Acre	Peter Henderson & Co., N. Y.	Do.
Henderson Premier	do	Do.
Late Flat Dutch	do	Do.
Penn State Ballhead	W. Atlee Burpee Co., Pa., Penn.	Do.
Premier Flat Dutch	do	Do.
Red Dutch	Peter Henderson & Co., N. Y.	Do.
Round Red Dutch	W. Atlee Burpee Co., Pa., Penn.	Do.
Shanghai	Local seed store	China.
Special Succession	Steckler Seed Co., Inc., La.	U. S. A.
Stein's Flat Dutch	Peter Henderson & Co., N. Y.	Do.
Succession	W. Atlee Burpee Co., Pa., Penn.	Do.
Surehead	do	Do.
Sutton's Allheart	Sutton and Sons, Reading	England.
Sutton's Earliest	do	Do.
Sutton's Favorite	do	Do.
Sutton's Flower of Spring	do	Do.
Sutton's Maincrop	do	Do.

In this study, the varieties tested were not all planted throughout the duration of the experiment, neither were they planted at

the same time. From 10 to 15 different varieties were tested in one year. The method followed was by trial and elimination, that is, out of a number of varieties tested in the first year, only those found promising by actual performance, and another batch of new varieties, to take the places of those eliminated, were ordered for planting the following year. So that it will be seen that some varieties were tested continuously, while others were only tested in a year, two or more.

DESCRIPTION OF VARIETIES

The aim here is to give some of the distinguishing characteristics of the varieties that have been tried in this study. Owing to the fact that over 30 varieties were included in this study, only the varieties that were found promising and those possessing some special merit are described. The work of Boswell *et al.* (1934) on the description of types of American cabbage varieties was freely consulted.

It may be stated here that during the course of the study, the different varieties showed distinguishable variations not only in the number of days to maturity but also in foliage characteristic, head formation, etc. as has also been reported in the United States by Boswell *et al.* (1934).

Allhead Early.—One of the best yielding varieties tested. Plant large but rather dwarf; leaves large, not numerous, lower ones quite spreading, bases spatulate to petioled. Leaves near head do not stand well above head thus exposing them to good view. Ribs medium, veins though not big are conspicuous. Bloom medium heavy, color of leaf gray green. Head big, round to rather flat on top, wider than thick. Head rather compact, although rather loose at lower portions. Core medium large, length about 50 per cent of head (Plate 4).

Allhead Select.—Has the general characteristics of Allhead Early. The plant, however, is smaller, and the head seems to be more compact (Plate 5).

Autumn King.—Plant large; leaves large, petioled, lower ones spreading and upper curving upward forming a cup-like appearance. Ribs and veins quite prominent; bloom rather heavy, leaf color light gray green. Head round to oblong, with few outer leaves; cross-section circular. Head quite hard and compact, core medium, length about 50 per cent of head (Plate 10).

Charleston Wakefield.—The best yielder among those with pointed heads. Sometimes called Large Wakefield. Plant me-

dium large, appearing somewhat like Early Jersey Wakefield. Leaves large and spreading, ribs and veins prominent; bloom medium thus appearing lighter in color than Early Jersey Wakefield. Stem medium size and generally short. Head pointed, medium size, approximately circular in cross-section. Moderately firm, though not very hard. Core medium size, about 45 to 50 per cent of length of head (Plate 6).

Copenhagen Market.—An early maturing variety of medium size. Leaves medium in number although at times numerous resulting in small head. Leaves distinctly and uniformly curved and appearing like the bowl of a rounded spoon. Plant with heads have a characteristic of well-trimmed and glossy appearance. Ribs and veins are medium size, but conspicuous because of light color. Stem small and short. Head more or less spherical, medium size and is generally hard and compact. Core about 55 per cent thickness of the head.

Danish Roundhead.—Plant medium size; leaves medium, spatulate at base and rather closely arranged forming a cup-like appearance. Inner leaves stand well over head. Ribs rather small, veins inconspicuous; bloom quite heavy. Stem small but rather long. Head small to medium size, round and hard. Leaves inside well compact on upper portion of head, but rather loose at the base. Core medium large, length about 66 per cent of head (Plate 14).

Early Flat Dutch.—Similar to Stein's Flat Dutch (Plate 12).

Early Jersey Wakefield.—A popular early maturing variety of the heart-shaped types. Plant small with few outside leaves, rarely petioled, smooth dark green; bloom slight, and veins not prominent. Stem small and short. Head small and pointed, firm but not very hard. Core medium, length about 50 per cent of the head.

Early Market.—A small round-headed variety, early maturing. Few outer leaves that curve inward thus protecting the head. Leaves and veins free from coarseness. The head is small, round and compact and has the tendency to become hard before full development.

Early Stonehead.—Plant large; leaves large, spreading, base petioled, leaf-blade rather curl. Ribs and veins rather prominent. Bloom quite heavy, leaf color silver gray. Stem medium large, but short, internodes short. Head medium to large, more or less spherical, hard, inside leaves crumpled and compact, cross-section circular. Core small, length 25 to 30 per cent of

head (Plate 11). Eating quality excellent, cabbage odor not pronounced.

Early Winnigstadt.—Plant medium large; leaves large, bases usually distinctly petioled, ribs and veins quite prominent, bloom heavy, leaf color distinctly greenish gray. Stem medium size, rather long. Head small to medium size, pointed; cross-section circular. Top of head small pointed with tips of outer leaves forming tuff about point. Head rather loose; core small but long about 50 to 55 per cent of head (Plate 13).

Enkhuizen Glory.—Plant of medium size; leaves quite numerous, rarely petioled, curved upward and extending slightly above head. Ribs and veins quite conspicuous; bloom rather heavy, leaf color gray-green. Stem small and short. Head more or less spherical, medium size with circular cross-section. Head very hard with interior leaves crumpled but compact. Core medium, length about 45 to 50 per cent of head (Plate 9). Texture tender and crisp, flavor good.

Golden Acre.—A small but early variety. Leaves few, rib and veins rather prominent. Bloom medium heavy. Head generally round and firm, and is capable of remaining in the field for a long time without bolting. Quality fine.

Henderson Premier.—Small and early maturing—round headed. Plant is compact and can be planted closer than other small varieties. Head very firm, tender and succulent. Very good for salad purposes.

Late Flat Dutch.—Plant very large and of open spreading appearance; leaves numerous, bases spatulate to petioled, blades curved upward slightly; leaves near head erect, standing well above top of head. Ribs and veins quite prominent; bloom heavy, leaf color light gray green. Head generally flat, large; cross-section more or less circular. Head quite hard, leaves inside crumpled and medium compact. Core medium large, length about 50 per cent of head (Plate 8).

Premium Flat Dutch.—Very similar to Late Flat Dutch in appearance and field characteristics.

Shanghai.—A Chinese variety, extensively grown in Baguio and Trinidad Valley because of its adaptability to rainy season culture, its high resistance to fungus diseases and because of its heavy production. Plant enormously large, maturing in 5 to 6 months. Leaves numerous with silvery gray color with lower ones spreading. Bases generally petioled, ribs and veins quite prominent; bloom heavy; stem large and quite long. Head very

big, round to rather flat in shape, medium hard, leaves inside crumpled and not so compact particularly at the lower portions. Core large, length about 50 to 55 per cent of head. Quality very poor and coarse, and has a very objectionable strong "cabbage" odor. Has the tendency to flower under Philippine conditions.

Special Succession.—Similar to Succession (Plate 2).

Stein's Flat Dutch.—Plant medium in size; leaves quite numerous, generally spatulate at bases, blade turn upward resembling a cup-like formation. Ribs and veins not so prominent, bloom quite heavy. Head medium large, and top generally flattened. Head rather hard and compact. Core medium large, length about 50 to 55 per cent of head (Plate 12).

Succession.—The best all season cabbage variety among those tested in the lowland, a heavy yielder and a sure cropper.

Plant large; leaves large but rather few, blade uniformly curved upward presenting a distinctly cup-shaped appearance and exposing the head to good view. Leaves generally spatulate at base, ribs and veins free from coarseness but characteristically conspicuous; bloom medium heavy; leaf color, light gray green. Stem medium large, rather short. Head big, more flattened than round; cross-section circular. The heads become solid long before it is fully grown so that heads of good size may be harvested before attaining full size. Head is hard with interior leaves crumpled but compact. Core medium large, length about 50 per cent of head (Plate 3).

Surehead.—Plant medium size; leaves quite numerous, base spatulate to petioled; blade curved slightly upward; leaves near head erect, standing well above it. Ribs and veins quite prominent; bloom medium heavy. Head medium size, round to flat; cross-section circular. Core medium large, length about 50 per cent of head (Plate 7).

CULTURES

In this study, 14 sets of planting were made covering a period of five years, from 1932 to the first half of 1937, inclusive. The cultures were conducted in four different experiment stations of the Bureau of Plant Industry; namely, the defunct Alabang Rice Station, Muntinlupa, Rizal; the Central Experiment Station, Manila; Lipa Coffee-Citrus Station, Lipa, Batangas; and the Los Baños Economic Garden, Los Baños, Laguna. Table 2 gives the different sets of cultures, the year when they were conducted and also the experiment stations where they were undertaken.

TABLE 2.—*Showing where the different cultures were undertaken and the year when conducted*

Vegetable season when cultures were made	Culture	Experiment Station where cultures were made
1932–1933	A	Alabang Rice Station, Muntinglupa, Rizal.
1933–1934	B	Central Experiment Station, Manila.
Do	C	Do.
Do	D	Lipa, Coffee-Citrus Station, Lipa, Batangas.
Do	E	Do.
1934–1935	F	Central Experiment Station, Manila.
Do	G	Do.
Do	H	Los Baños Economic Garden, Los Baños, Laguna.
Do	I	Do.
1935–1936	J	Central Experiment Station, Manila.
Do	K	Los Baños Economic Garden, Los Baños, Laguna.
1936–1937	L	Central Experiment Station, Manila.
Do	M	Lipa, Coffee-Citrus Station, Lipa, Batangas.
Do	N	Los Baños Economic Garden, Los Baños, Laguna.

Culture A was undertaken by the senior author alone at the defunct Alabang Rice Station during the 1932–1933 vegetable season. The field was of gentle slope and the soil was from medium to heavy clay in texture. Since this was the first attempt at growing cabbage in that station, and station employees as well as neighboring farmers were rather skeptical as to the success of the trial, some extra treatment was provided in the preparation of the soil for planting. This was deemed necessary because of the heavy nature of the soil. This treatment consisted in putting one shovelful of well-rotted stable manure in each of the holes into which the seedlings were to be set in. The holes were spaced 50 centimeters apart in rows set at 60 centimeters far apart. The cabbage seedlings were set in the manure without being mixed with the soil, in order to have a mellow medium for the roots of the young plants to develop.

The varieties used in Culture A were Autumn King, Copenhagen Market, Danish Ballhead, Early Market, Early Summer, Stein's Flat Dutch and Succession. In Cultures B, C, D, and E the varieties Allhead Early, Charleston Wakefield, Copenhagen Market, Early Jersey Wakefield, Early Krop, Early Market, Golden Acre, Henderson Premier, Red Dutch, and Succession were used. For Culture F, the varieties Charleston Wakefield, Early Dwarf Flat Dutch, Early Jersey Wakefield, Golden Acre, Late Flat Dutch, Henderson Premier, Shanghai and Succession were tested. The same varieties with the exception of Early Dwarf Flat Dutch, Early Jersey Wakefield and Shanghai were used in Culture G. Sutton's Allheart, Sutton's Earliest, Sutton's

Favorite, Sutton's Flower of Spring and Sutton's Maincrop were also tested in Culture G. Five varieties were tested in Culture H; namely, Charleston Wakefield, Golden Acre, Henderson Premier, Late Flat Dutch, and Succession. With the exception of Henderson Premier, the same varieties were tested in Culture I in addition to Sutton's Allheart, Sutton's Earliest, Sutton's Favorite, Sutton's Flower of Spring and Sutton's Maincrop. In Cultures J and K the following varieties were tested: Allhead Early, Charleston Wakefield, Danish Ballhead, Early Winnigstadt, Enkhuizen Glory, Penn State Ballhead, Premium Flat Dutch, Round Red Dutch, Special Succession, Succession, and Surehead. In Cultures L, M, and N, 14 varieties were included in the study; namely, Allhead Early, Allhead Select, All Seasons, Autumn King, Charleston Wakefield, Danish Roundhead, Early Stonehead, Enkhuizen Glory, Golden Acre, Penn State Ballhead, Premium Flat Dutch, Stein's Flat Dutch, Succession, and Surehead.

With the exception of the soil of the Central Experiment Station plots which was comparatively deep sandy loam, the soils of the culture plots in the Lipa Coffee-Citrus Station and in the Los Baños Economic Garden were loamy in nature and comparatively shallow, the depth ranging from about 40 to 60 centimeters, and underlaid with adobe soil. The ground, nevertheless, had very gentle slope and the soils were fairly uniform. No attempt, however, was made to determine the comparative fertility of the soils in the different stations.

In all the cultures, the same method of planting was used—the bed system—each bed containing two rows. The seedlings were raised first in seed beds and when they were from 4 to 5 weeks old, they were transplanted in the garden plots. The actual distancing in the beds was 60 centimeters between the rows, and 50 centimeters between the plants in the rows. However, because of the allowances for paths between beds, the distancing on the hectare basis would be 75 centimeters between rows and 50 centimeters between plants so that in a hectare there would be 26,667 plants.

In the gathering of data, the weight of the cabbage head or the yield of a plot was considered as the main criterion for comparison. Also, the number of days to maturity, the comparative solidity of the head, the relative resistance to pests and diseases and their eating quality were noted. However, no critical study of these latter characters was attempted.

In the different tests, either the plant or the plot was considered as the unit. In some cases some of the seeds ordered had poor germination thus limiting the number of seedlings obtainable for transplanting. Where one or more varieties were represented only by a plot, the plant was considered as the unit for that set of culture; but in cases where two or more plots were used for the variety with the least number of representative plants, the plot was considered as the unit.

As much as possible, the different sets of cultures were given practically the same treatments, especially with respect to cultivation and weeding, watering, spraying and fertilizing. While the spacing between rows and plants was maintained throughout, the size of the plots in the different cultures could not be made of equal area.

Because of the great bulk of the data gathered in this study, only the summary of the results of each culture is presented here. The complete original data were filed with the Horticulture Section of this Bureau.

EXPERIMENTS AND RESULTS

Culture A.—This study was undertaken from December, 1932 to March, 1933. The planting was rather late and the crop was affected by the easterly wind prevalent from February to April. In spite of the heavy nature of the soil and the rather late planting, the stand of the crop was good. Seven varieties were included in this study. Table 3 gives a summary of the results of this culture giving the number of days to maturity, per cent heading, the average weight per head, and the computed yield per hectare.

TABLE 3.—*Showing the number of days to maturity, per cent heading and yield of different cabbage varieties at the Alabang Rice Station*

(CULTURE A)

Variety name	Days to maturity	Per cent heading	Average weight per head	Yield per hectare[1]
			Kilo	*Kilo*
Autumn King	92–109	88	0.54±0.017	12,672
Copenhagen Market	81–102	98	0.72±0.016	18,816
Danish Ballhead	90–108	90	0.27±0.009	6,480
Early Market	80–102	98	0.57±0.017	14,896
Early Summer	92–108	98	0.55±0.020	14,374
Stein's Flat Dutch	90–109	75	0.57±0.008	11,400
Succession	83–106	97	0.83±0.026	21,470

[1] The yield was computed on the basis of 26,667 plants (50 × 75 centimeters) per hectare.

Cultures B and C.—Both of these cultures were undertaken during the 1933–1934 vegetable season at the Central Experiment Station. Culture B took place from January to March, 1934, and Culture C, from February to April of the same year. Ten varieties were tested in both cultures. Table 4 presents a summary of the results of these cultures.

TABLE 4.—*Comparative yields of different varieties of cabbage at the Central Experiment Station, Manila, 1933–1934 vegetable season*

Variety name	January–March, 1934 planting (Culture B)			February–April, 1934 planting (Culture C)		
	Per cent heading	Average weight per head	Computed yield per hectare[1]	Per cent heading	Average weight per head	Computed yield per hectare[1]
		Grams	*Kilos*		*Grams*	*Kilos*
Allhead Early	95	614.3±33.38	15,562	92	490.5±23.96	12,034
Charleston Wakefield	100	602.7±34.39	16,072	82	686.3±21.15	15,007
Copenhagen Market	74	463.0±28.28	9,137	63	364.2±19.74	6,119
Early Jersey Wakefield	85	402.0±19.74	9,112	66	461.3±21.54	8,119
Early Krop	93	324.5±23.81	8,048	61	369.1±15.13	6,004
Early Market	85	237.3±15.11	5,379	82	391.6±18.62	8,563
Golden Acre	93	378.2±22.29	9,379	100	425.2±22.69	11,339
Henderson Premier	90	331.6±16.59	7,959	92	469.7±18.54	11,523
Red Dutch	83	175.7± 9.13	4,685	82	263.5±15.25	5,762
Succession	100	568.5±26.17	15,160	100	688.1±27.25	18 350

[1] The yield was computed on the basis of 26,667 plants (50 × 75 centimeters) per hectare.

Cultures D and E.—These cultures were also undertaken during the 1933–1934 vegetable season at the Lipa Coffee-Cetrus Station. Culture D took place from November, 1933 to February, 1934, while Culture E, from January to April, 1934. Ten varieties were tested in these studies. Both cultures were good, especially the first. Table 5 presents a summary of the results of these cultures.

Cultures F and G.—These cultures took place during the 1934–1935 vegetable season at the Central Experiment Station in Manila. Culture F was planted in October, 1934, while Culture G, in December of the same year. Eight varieties were tested in both cultures. Table 6 gives a summary of the results of said cultures.

TABLE 5.—*Showing the comparative yields of different varieties of cabbage at the Lipa Coffee-Citrus Station*

Variety name	November–February, 1934 planting (Culture D)			January–April, 1934 planting (Culture E)		
	Area of plot	Average yield of plot	Computed yield per hectare	Area of plot	Average yield of plot	Computed yield per hectare
	Sq. m.	*Kilos*	*Kilos*	*Sq. m.*	*Kilos*	*Kilos*
Allhead Early	11.25	43.40±1.36	38,578	11.25	21.25±0.51	18,889
Charleston Wakefield	11.25	28.92±1.19	25.707	11.25	19.15±0.81	17,022
Copenhagen Market	11.25	15.61±0.57	13,876	11.25	12.86±0.65	11.431
Early Jersey Wakefield	11.25	19.72±1.22	17,520	11.25	18.36±0.99	16,320
Early Krop	11.25	13.42±0.38	11,929	11.25	15.59±0.70	13.857
Early Market	11.25	17.53±0.70	15,581	11.25	15.90±0.36	14,133
Golden Acre	11.25	17.02±0.54	15,129	11.25	16.75±0.77	14.889
Henderson Premier	11.25	14.92±1.21	13,262	11.25	14.99±0.52	13,324
Red Dutch	11.25	10.96±0.36	8,853	11.25	7.28±0.68	6,471
Succession	11.25	54.01±1.36	48,009	11.25	25.38±1.01	22.471

TABLE 6.—*Comparative yields of different varieties of cabbage at the Central Experiment Station, 1934–1935 vegetable season*

Variety name	Planted, October, 1934 (Culture F)			Planted, December, 1934 (Culture G)		
	Per cent heading	Average weight per head	Computed yield per hectare[1]	Per cent heading	Average weight per head	Computed yield per hectare[1]
		Grams	*Kilos*		*Grams*	*Kilos*
Charleston Wakefield	75	495.9±29.03	9,918	98	631.4±23.89	16.501
Early Dwarf Flat Dutch	83	156.2±10.87	3,457	------	------	------
Early Jersey Wakefield	70	299.5±15.90	5,217	------	------	------
Golden Acre	78	319.0±14.04	6,635	98	376.4±12.66	9,837
Late Flat Dutch	96	761.3±38.61	19,287	83	675.6±30.68	15,074
Henderson Premier	78	213.5±13.84	4.441	93	364.2±16.66	9,032
Shanghai	43	1317.0±62.22	15,102	------	------	------
Succession	98	560.0±38.15	14,635	95	894.6±31.48	22,483
Sutton's Allheart	------	------	------	57	444.7±24.35	6,759
Sutton's Earliest	------	------	------	71	276.3±12.57	5,231
Sutton's Favorite	------	------	------	19	272.1±24.68	1,379
Sutton's Flower of Spring	------	------	------	(2)	------	------
Sutton's Mainkrop	------	------	------	(2)	------	------

[1] The yield was computed on the basis of 26,667 plants (50 × 75 centimeters) per hectare.
[2] Did not produce any head in spite of good vegetative growth.

Cultures H and I.—These cultures were run in the Los Baños Economic Garden during the 1934–1935 vegetable season. Culture H which was composed of five varieties was started in December, 1934, while Culture I was started in January, 1935. In the latter culture nine varieties were studied. A summary of the results of both cultures is presented in Table 7.

TABLE 7.—*Comparative yields of different varieties of cabbage at the Los Baños Economic Garden, 1934–1935 vegetable season*

Variety name	Planted, December, 1934 (Culture H)			Planted, January, 1935 (Culture I)		
	Per cent heading	Average yield per plot	Computed yield per hectare	Per cent heading	Average yield per plot	Computed yield per hectare
		Kilos	*Kilos*		*Kilos*	*Kilos*
Charleston Wakefield	95	17.04±0.45	18,933	89	11.03±0.41	12,256
Golden Acre	95	9.48±0.19	10,633	91	9.49±0.19	10,544
Henderson Premier	97	8.54±0.21	9,489			
Late Flat Dutch	94	22.17±0.60	24,633	83	11.86±0.61	13,178
Succession	97	17.94±0.37	19,933	87	11.99±0.49	13,322
Sutton's Allheart				22	3.08±0.19	3,311
Sutton's Earliest				70	4.73±0.28	5,255
Sutton's Favorite				22	1.22±0.18	1,355
Sutton's Flower of Spring				11	0.70±0.11	778
Sutton's Mainkrop				2	0.16±0.30	178

Cultures J and K.—Both cultures were undertaken during the 1935–1936 vegetable season. Culture J was conducted at the Central Experiment Station while Culture K, at the Los Baños Economic Garden. Ten varieties were tested in Culture J while 11 varieties in Culture K. Table 8 gives a summary of the results of both cultures.

Cultures L, M, and N.—These cultures were conducted during the 1936–1937 vegetable season. Culture L was undertaken at the Central Experiment Station, Culture M, at the Lipa Coffee-Citrus Station, and Culture N, at the Los Baños Economic Garden. Culture N was a total failure because of the typhoon that struck the Los Baños Economic Garden when the seedlings were being raised. Culture M, on the other hand, was badly damaged by soft rot, hence it was deemed necessary to exclude the data obtained. Table 9 presents a summary of the results of Culture L.

TABLE 8.—*Comparative yields of different cabbage varieties at the Central Experiment Station and Los Baños Economic Garden, 1935–1936 vegetable season.*

Variety name	Test at Central Experiment Station (Culture J)			Test at Los Baños Economic Garden (Culture K)		
	Area of plot	Average yield per plot	Computed yield per hectare	Area of plot	Average yield per plot	Computed yield per hectare
	Sq. m.	*Kilos*	*Kilos*	*Sq. m.*	*Kilos*	*Kilos*
Allhead Early	5.5	2.87±0.06	5,218	16.5	25.32±0.86	15,345
Charleston Wakefield	5.5	7.09±0.39	12,892	16.5	18.17±1.33	11,012
Danish Ballhead	5.5	3.35±0.43	6,092	16.5	17.00±0.84	10,303
Early Winnigstadt	5.5	5.43±0.21	9,873	16.5	10.88±2.71	6,594
Enkhuizen Glory	5.5	7.15±0.23	13,000	16.5	27.12∓1.95	16,436
Penn State Ballhead	5.5	6.71±0.48	12,200	16.5	15.63±0.91	9,473
Premium Flat Dutch	5.5	3.88±0.82	7,055	16.5	32.90±1.85	19,939
Round Red Dutch	5.5			16.5	0.95±0.06	576
Special Succession	5.5	16.55±0.44	30,091	16.5	27.04±0.68	16,388
Succession [1]	5.5	7.65±0.02	13,909	16.5	30.38±2.73	18,412
Surehead	5.5	7.86±1.95	14,291	16.5	30.22±1.77	18,315

[1] These varieties in Culture J were badly attacked by worms before spraying was started, and consequently produced small sized-heads.

TABLE 9.—*Comparative yields of different varieties of cabbage at the Central Experiment Station, 1936–1937 vegetable season*

(CULTURE L)

Variety name	Days to mature	Per cent heading	Average weight per head	Yield per hectare [1]
			Kilos	*Kilos*
Allhead Early	101–132	87	0.83±0.064	19,257
Allhead Select	95–126	91	0.71±0.031	17,230
All Season	95–132	91	0.60±0.040	14,560
Autumn King	103–132	87	0.65±0.030	15,081
Charleston Wakefield	95–132	88	0.60±0.049	14,080
Danish Roundhead	101–132	48	0.44±0.073	5,632
Early Stonehead	103–132	85	0.59±0.029	13,374
Enkhuizen Glory	95–132	91	0.62±0.036	15,046
Golden Acre	86– 93	85	0.38±0.027	8,613
Penn State Ballhead	95–132	94	0.43±0.028	10,779
Premium Flat Dutch	95–132	85	0.84±0.062	19,040
Stein's Flat Dutch	95–132	91	0.61±0.043	14,803
Succession	93–106	94	0.58±0.019	14,539
Surehead	95–132	78	0.65±0.046	13,521

[1] The yield was computed on the basis of 26,667 plants (50 × 75 centimeters) per hectare.

In order to find the average yields of the different varieties as tested for a series of years in the different Stations, Tables 10, 11, 12 and 13 were prepared. Table 10 presents the average yields by stations of the varieties tested during the whole duration of the study at the Alabang Rice Station, Lipa Coffee-Citrus Station and Los Baños Economic Garden, while Table 11 gives the average yields of the varieties tested at the Central Experiment Station. Table 12, on the other hand, does not only give the average yields of the varieties tested at the Central Experiment Station, Lipa Coffee-Citrus Station and Los Baños Economic Garden, but it also gives the range in yields of the different varieties in the different stations and the number of tests or cultures made in each station.

Table 13 presents a summary of Tables 10, 11, and 12, giving the average yields of the different varieties as tested in the different stations. In addition, this table presents the range of yield of each variety, the number of stations where the tests were made, and the number of tests conducted.

Table 14 gives a list of the 15 best varieties in the order of their yielding capacity during the whole duration of the study.

DISCUSSION OF RESULTS

Contrary to the common belief that cabbage could be raised successfully only at high elevations like Baguio and Trinidad Valley, Mountain Province, Nueva Vizcaya and other high places, this study presents definite information that cabbage can be profitably grown also at sea level.

TEST AT THE ALABANG RICE STATION

One test was conducted at the defunct Alabang Rice Station. As seen in Table 3, all the varieties tested readily formed heads, the percentage of heading ranged from 75 in the case of Stein's Flat Dutch to 98 in the case of Copenhagen Market, Early Summer, and Early Market. The number of days to maturity ranged from 80 to 109 days—from sowing of seed to harvesting of the crop. Early Market, Copenhagen Market, and Succession were the earliest to mature. Succession in the first test was considered an early maturing variety because of the lack of acquaintance with the fact that the head of this variety becomes hard long before it is fully developed (1934). As has been found in subsequent tests, Succession is a medium maturing variety.

The average weight per head varied from 0.27 ± 0.009 to 0.83 ± 0.026 kilos based from 70 to 100 heads per variety. The best yielder was Succession with an average weight per head of 0.83 ± 0.026 kilos or a computed yield of 21,470 kilos a hectare followed by Copenhagen Market with a computed yield of 18,816 kilos per hectare (see Table 3). The poorest yielder was Danish Ballhead.

TESTS AT THE LIPA COFFEE-CITRUS STATION

Three tests were conducted in this station, two in 1933–1934 vegetable season and one in 1936–1937 season. Because of the severe attacks of soft rot, only the results of the first two cultures are presented in this report. As seen in Table 5, of the 10 varieties tested, Succession was the best yielder in both tests (Cultures D and E), the average computed yields per hectare being 48,009 and 22,471 kilos, respectively. The second best yielder (in these cultures) was Allhead Early with average yields of 38,578 and 18,889 kilos per hectare, followed by Charleston Wakefield and Early Jersey Wakefield.

It will be noted in Table 5 that as a rule Culture D (early dry season planting) gave higher yields than Culture E (late dry season planting). It was only in the case of Red Dutch, Early Krop and Henderson Premier that the latter culture gave higher yields. It is also interesting to note that the first four best yielders in the first test (Culture D) were also the first four best in the second best (Culture E).

TESTS AT THE LOS BAÑOS ECONOMIC GARDEN

As seen in Table 2, four cultures were conducted at the Los Baños Economic Garden during three vegetable seasons, 1934–1937, inclusive. Nineteen varieties were tested, and the different varieties were tested from one to three times.

The first and second cultures were conducted in the same year. In the first test (Culture H), five varieties were tested. The per cent heading of the varieties tested was high, ranging from 94 in the case of Late Flat Dutch to 97 in the case of Succession. The yield of these varieties varied from 9,489 to 24,633 kilograms per hectare. Late Flat Dutch was the best yielder with an average yield of 24,633 kilograms; Succession, second with an average yield of 19,933 kilograms; and Charleston Wakefield third with an average yield of 18,933 kilograms per hectare (see Table 7).

In the second test (Culture I), 9 varieties were tested. In this test, the per cent heading was rather low, ranging from 2 per cent in the case of Sutton's Maincrop to 91 per cent in the case of Golden Acre. As seen in Table 7, the yield was also poor; the yield ranged from 178 to 13,322 kilograms per hectare. It will be noted, however, that the best three yielders in the first test were also the best three in this test, although not in the same order. The best three yielders in this test in the order of their importance were Succession, Late Flat Dutch, and Charleston Wakefield with the corresponding yields of 13,322, 13,178 and 12,256 kilograms per hectare.

The third test (Culture K) at the Los Baños Economic Garden brought in new varieties that yielded about as much as the best in previous cultures. The promising new varieties in this test were Premium Flat Dutch, Surehead, Enkhuizen Glory, Special Succession and Allhead Early, the average yields of which being 19,939, 18,315, 16,436, 16,388 and 15,345 kilograms per hectare, respectively (see Table 8). Succession which was one of the best in Cultures H and I, gave a yield of 18,412 kilograms per hectare while Charleston Wakefield gave a yield of only 11,012 kilograms to the hectare.

Summing the results of the three cultures at the Los Baños Economic Garden which included 19 varieties, it may be stated that the yield per hectare ranged from 178 to 24,633 kilograms (see Tables 11 and 12). It is apparent from the results obtained that there were a number of varieties adapted to the conditions obtaining in the Los Baños Economic Garden and its environs. The best varieties so far found were Premier Flat Dutch, Late Flat Dutch, Surehead, Succession, Enkhuizen Glory, Special Succession, Allhead Early, and Charleston Wakefield.

TESTS AT THE CENTRAL EXPERIMENT STATION

As seen in Table 2, six cultures (B, C, F, G, J, and L) were conducted at the Central Experiment Station for a period of four vegetable seasons (1933–1937). Thirty varieties were tested during this period.

1933–1934 tests.—Two sets of cultures (Cultures B and C) were conducted during this season. In both cultures, the same ten varieties were tested. The general stand of the crops was good; the per cent heading in Culture B was from 74 to 100, and from 61 to 100 per cent in Culture C. The average computed yield per hectare in Culture B was from 4,685 to 16,072 kilo-

grams, and from 5,762 to 18,350 kilograms per hectare in Culture C. The best yielders in Culture B were Charleston Wakefield, Succession, and Allhead Early; while in Culture C the best yielders were Succession, Charleston Wakefield, and Allhead Early (see Table 5). Like in the Lipa Coffee-Citrus Station tests, the best yielders found in the early planting were also the best in the late planting.

1934–1935 test.—In the first planting (Culture F) eight varieties were tested including the Shanghai cabbage which is commonly grown in Baguio and Trinidad Valley during the rainy season (1933). The per cent heading varied from 43 in the case of Shanghai to 98 in the case of Succession, and the yield ranged from 3,457 to 19,287 kilograms per hectare. Late Flat Dutch was the best yielder, followed by Shanghai, and Succession was third. While Late Flat Dutch was the best in yield, Shanghai has the biggest head, averaging in weight, 1.317 ± 0.062 kilograms a head as against 0.761 ± 0.039 kilograms of Late Flat Dutch, and 0.560 ± 0.038 kilograms for Succession. Shanghai, however, had a very low percentage heading (see Table 6) and is a very late maturing variety.

In the second culture (Culture G), which was planted in December, 1934, Succession was the heaviest yielder with 22,483 kilograms per hectare to its credit; Charleston Wakefield, second; and Late Flat Dutch, third, the average yields being 16,501 and 15,074 kilograms per hectare, respectively (see Table 6).

Of the five English varieties tested, two did not produce heads at all in spite of excellent vegetative growth while the other three varieties had a percentage heading ranging from 19 to 71. This indifferent performance of the English varieties was similar to their showing in the Los Baños Economic Garden, although in the latter station all the varieties were able to produce some heads.

1935–1936 culture.—One culture (Culture J) was conducted in this season in which 10 varieties were tested. The yield of this culture varied from 5,218 to 30,091 kilograms per hectare with Special Succession as the best yielder. The next four best yielders were Surehead, Succession, Enkhuizen Glory and Charleston Wakefield, the corresponding yields of which being 14,291, 13,909, 13,000 and 12,892 kilograms per hectare.

1936–1937 test.—In this culture (Culture L) 14 varieties were studied with four varieties tested for the first time. The stand of the culture was good, the heading ranging from 48 per cent

in the case of Danish Roundhead to 94 per cent in the case of Penn State Ballhead. In size of head, Golden Acre was the smallest, the average weight per head being 0.38 ± 0.027 kilograms. Premium Flat Dutch, Allhead Early and Allhead Select produced the biggest heads, the average weight being 0.84 ± 0.062, 0.83 ± 0.064, and 0.71 ± 0.031 kilograms per head, respectively. Based on yield per hectare, the five best yielders in this culture were Allhead Early, Premium Flat Dutch, Allhead Select, Autumn King, and Enkhuizen Glory. The average yields of these varieties were 19,257, 19,040, 17,230, 15,080 and 15,046 kilograms per hectare, respectively (see Table 9). It will be noted that Succession, one of the best in previous cultures in all stations had only a yield of 14,539 kilograms to the hectare. It may be remarked in this connection that the plots planted to this variety were adjacent to a soybean field and the plants were badly attacked by worms before regular spraying was started.

The results of the Central Experiment Station cultures (Cultures B, C, F, G, J, and L) are summarized in Table 11. Upon examination of this table, it will be seen that 31 varieties have been tested, and two (English) varieties failed to produce heads. The 29 varieties gave average yields ranging from 1,379 to 30,091 kilograms per hectare. The best 10 yielders in their descending order were Special Succession, Allhead Select, Late Flat Dutch, Succession, Shanghai, Autumn King, Stein's Flat Dutch, All Seasons, Charleston Wakefield, and Enkhuizen Glory. It will be noted, however, that varieties Special Succession, Allhead Select, Shanghai, Autumn King, Sein's Flat Dutch, and All Seasons were represented by one culture each; while Late Flat Dutch and Enkhuizen Glory by two tests each; and Succession and Charleston Wakefield by six cultures each.

VARIETIES BEST ADOPTED TO THE DIFFERENT STATIONS

It was rather unfortunate that because of limited facilities it was not possible to test all the varieties and conduct the cultures at the same time in the different stations. With the data here presented it would not be fair to make a comparison of the yields of the different varieties in the different stations. At least, however, the best varieties among those tested in each station may be pointed out for the benefit of gardeners and would-be truckers in the vicinity of those different localities.

Based from one season test, the best for Alabang are Succession and Copenhagen Market (see Table 3). As seen in Table

12, the best cropper under Lipa conditions are Succession, Allhead Early, Charleston Wakefield, Early Jersey Wakefield, and Golden Acre. Under Los Baños conditions, the five best varieties are Premier Flat Dutch, Late Flat Dutch, Surehead, Succession, and Enkhuizen Glory. Charleston Wakefield may be included because of its consistently good performance during three tests (see Table 12).

At the Central Experiment Station, Manila, the five best varieties are Special Succession, Allhead Select, Late Flat Dutch, Succession, and Charleston Wakefield. Special Succession and Allhead Early which were tested for only one season gave average yields of 30,091 and 17,230 kilograms per hectare, respectively. On the other hand, Late Flat Dutch had an average yield of 17,180 kilograms per hectare for two cultures while Succession and Charleston Wakefield gave average yields of 16,513 and 14,078 kilograms per hectare, respectively, for six tests. The range in yield of Succession was from 13,909 to 22,483 kilograms per hectare while the yield of Charleston Wakefield ranged from 9,918 to 16,072 kilograms per hectare.

AVERAGE YIELDS IN ALL STATIONS

As already stated elsewhere, Table 13 presents the average yields of all the varieties tested in the different stations from 1933 to 1937. As shown in Table 13, 33 varieties were tested; 8 varieties were tested in one station only; 17 varieties in two stations; 7 varieties in 3 stations; and 1 variety in 4 stations. Eight varieties were tested only once; 9 varieties, two times; 5 varieties, three times; 3 varieties, four times; 3 varieties, five times; 2 varieties, seven times; 1 variety, nine times, 1 variety, eleven times; and 1 variety, twelve times. It is also seen in Table 13 that the average yields of the different varieties in all the stations where the studies were conducted ranged from 178 to 23,239 kilograms per hectare.

BEST YIELDING VARIETIES

In Table 14 is presented a list of the 15 heaviest yielding varieties found in this study. The average yields of these varieties ranged from 13,102 to 23,239 kilograms per hectare. These varieties in the descending order of their average yields are Special Succession, Succession, Late Flat Dutch, Allhead Early, Allhead Select, Charleston Wakefield, Surehead, Premium Flat Dutch, Shanghai, Enkhuizen Glory, All Seasons, Early Summer, Autumn King, Early Stonehead, and Stein's Flat Dutch.

TABLE 10.—*Average yields per hectare of different cabbage tested at Alabang Rice Station, Lipa Coffee-Citrus Station and Los Baños Economic Garden*

Variety name	Alabang Rice Station	Lipa Coffee-Citrus Station			Los Baños Economic Garden			
	1932–1933	Nov.–Feb., 1933–1934	Jan.–April, 1934	Average	Dec., 1934	Jan., 1935	1935–1936	Average
	Kilo	*Kilo*	*Kilo*	*Kilo*	*Kilo*	*Kilo*	*Kilo*	*Kilo*
Allhead Early		38,578	18,889	28,733			15,345	15,345
Autumn King	12,672							
Charleston Wakefield		25,707	17,022	21,364	18,933	12,256	11 012	14,067
Copenhagen Market	18,816	13,876	11,431	12,653				
Danish Ballhead	6,480						10,303	10,303
Early Jersey Wakefield		17,520	16,320	16,920				
Early Krop		11,929	13,857	12,893				
Early Market	14,896	15,581	14,133	14,857				
Early Summer	14,374							
Early Winnigstadt							6,594	6,594
Enkhuizen Glory							16,436	16,436
Golden Acre		15,129	14,889	15,009	10,633	10,544		10,588
Henderson Premier		13,262	13,324	13,293	9,489			9,489
Late Flat Dutch					24,633	13,178		18,905
Penn State Ballhead							9,473	9,473
Premium Flat Dutch							19,939	19,939
Red Dutch				7,662				
Round Red Dutch							576	576
Special Succession							16,388	16,388
Stein's Flat Dutch	11,400							
Succession	21,470	48,009	22,471	35,240	19,933	13,322	18,412	17,222
Surehead							18,315	18,315
Sutton's Allheart						3,311		3,311
Sutton's Earliest						5,255		5,255
Sutton's Favorite						1,355		1,355
Sutton's Flower of Spring						778		778
Sutton's Maincrop						178		178

TABLE 11.—*Average yields of cabbage varieties tested at the Central Experiment Station, 1933–1937*

Variety name	Dec.-Mar., 1933–1934	Feb.–Apr., 1934	Oct., 1934	Dec., 1934	1935–1936	1936–1937	Average
	Kilo	*Kilo*	*Kilo*	*Kilo*	*Kilo*	*Kilo*	*Kilo*
Allhead Early	15,562	12,034			5,218	19,257	13,018
Allhead Select						17,230	17,230
All Seasons						14,560	14,560
Autumn King						15,081	15,081
Charleston Wakefield	16,072	15,007	9,918	16,501	12,892	14,080	14,078
Copenhagen Market	9,137	6,119					7,628
Danish Ballhead					6,092		6,092
Danish Roundhead						5,632	5,632
Early Dwarf Flat Dutch			3,457				3,457
Early Jersey Wakefield	9,112	8,119	5,217				7,483
Early Krop	8,048	6,004					7,026
Early Market	5,379	8,563					6,971
Early Stonehead						13,374	13,374
Early Winnigstadt					9,873		9,873
Enkhuizen Glory					13,000	15,046	14,023
Golden Acre	9,379	11,339	6,635	9,837		8,613	9,161
Henderson Premier	7,959	11,523	4,441	9,032			8,239
Late Flat Dutch			19,287	15,074			17,180
Penn State Ballhead					12,200	10,779	11,490
Premium Flat Dutch					7,055	19,040	13,048
Red Dutch	4,685	5,762					5,224
Shanghai			15,102				15,102
Special Succession					30,091		30,091
Stein's Flat Dutch						14,803	14,803
Succession	15,160	18,350	14,635	22,483	13,909	14,539	16,513
Surehead					14,291	13,521	13,906
Sutton's Allheart				6,759			6,759
Sutton's Earliest				5,231			5,231
Sutton's Favorite				1,379			1,379
Sutton's Flower of Spring				(1)			
Sutton's Maincrop				(1)			

[1] The plants did not produce any head in spite of excellent vegetative growth.

TABLE 12.—*Comparative average yields of cabbage in different stations.*

Variety name	Central Experiment Station			Lipa Coffee-Citrus Station			Los Baños Economic Garden		
	Number of tests	Average yield per hectare	Range in yield per hectare	Numbe of tests	Average yield per hectare	Range in yield per hectare	Number of tests	Average yield per hectare	Range in yield per hectare
		Kilo	*Kilo*	*Kilo*	*Kilo*	*Kilo*	*Kilo*	*Kilo*	*Kilo*
Allhead Early	4	13,018	5,218–19,257	2	28,733	18,889–38,578	1	15,345	15,345
Allhead Select	1	17,230	17,230						
All Seasons	1	14,560	14,560						
Autumn King	1	15,081	15,081						
Charleston Wakefield	6	14,078	9,918–16,072	2	21,364	17,022–25,707	3	14,047	11,012–18,933
Copenhagen Market	2	7,628	6,119–9,137	2	12,653	11,431–13,876			
Danish Ballhead	1	6,092	6,092				1	10,303	10,303
Danish Roundhead	1	5,632	5,632						
Early Dwarf Flat Dutch	1	3,457	3,457						
Early Jersey Wakefield	3	7,483	5,217–9,112	2	16,920	16,320–17,520			
Early Krop	2	7,026	6,004–8,048	2	12,893	11,929–13,857			
Early Market	2	6,971	5,379–8,563	2	14,857	14,133–15,581			
Early Stonehead	1	13,374	13,374						
Early Summer									
Early Winnigstadt	1	9,873	9,873				1	6,594	6,594
Enkhuizen Glory	2	14,023	13,000–15,046				1	16,436	16,436
Golden Acre	5	9,161	6,635–11,339	2	15,009	14–889–15,129	2	10,588	10,544–10,633
Henderson Premier	4	8,239	4,441–11,523	2	13,293	13–262–13,324	1	9,489	9,489
Late Flat Dutch	2	17,180	15,074–19,287				2	18,905	13,178–24,633
Penn State Ballhead	2	11,490	10,779–12,200				1	9,473	9,473
Premier Flat Dutch	2	13,048	7,055–19,040				1	19,939	19,939
Red Dutch	2	5,224	4,685–5,762	2	7,662	6,471–8,853			
Round Red Dutch							1	576	576
Shanghai	1	15,102	15,102						
Special Succession	1	30,091	30,091				1	16,388	16,388
Stein's Flat Dutch	1	14,803	14,803						
Succession	6	16,513	13,909–22,483	2	35,240	22,471–48,009	3	17,222	13,322–19,933

Surehead	2	13,906	13,521–14,291			1	18,315	18,315
Sutton's Allheart	1	6,759	6,759			1	3,311	3,311
Sutton's Earliest	1	5,231	5,231			1	5,255	5,255
Sutton's Favorite	1	1,379	1,379			1	1,355	1,355
Sutton's Flower of Spring	1	[1]				1	778	778
Sutton's Maincrop	1	[1]				1	178	178

[1] These varieties did not produce heads in spite of excellent vegetative growth.

TABLE 13.—*Average yields of cabbage varieties tested in different stations from 1933 to 1937 inclusive*

Variety name	Number of stations where test made	Number of tests made	Average yield per hectare	Range in yield per hectare	Variety name	Number of stations where test made	Number of tests made	Average yield per hectare	Range in yield per hectare
			Kilo	*Kilo*				*Kilo*	*Kilo*
Allhead Early	3	7	17,840	5,218–38,578	Henderson Premier	3	7	9,831	4,441–13,324
Allhead Select	1	1	17,230	17,230	Late Flat Dutch	2	4	18,043	13,178–24,633
All Seasons	1	1	14,560	14,560	Penn State Ballhead	2	3	10,484	9,473–12,200
Autumn King	2	2	13,877	12,672–15,081	Premium Flat Dutch	2	3	15,345	7,055–19,939
Charleston Wakefield	3	11	15,400	9,918–25,707	Red Dutch	2	4	6,443	4,685– 8,853
Copenhagen Market	3	5	11,876	6,119–18,816	Round Red Dutch	1	1	576	576
Danish Ballhead	3	3	7,625	6,092–10,303	Shanghai	1	1	15,102	15,102
Danish Roundhead	1	1	5,632	5,632	Special Succession	2	2	23,239	16,388–30,091
Early Dwarf Flat Dutch	1	1	3,457	3,457	Stein's Flat Dutch	2	2	13,102	11,400–14,803
Early Jersey Wakefield	2	5	11,257	5,217–17,520	Succession	4	12	20,224	13,322–48,009
Early Krop	2	4	9,959	6,004–13,857	Surehead	2	3	15,376	13,521–18,315
Early Market	3	5	11,710	5,379–15,581	Sutton's Allheart	2	2	5,035	3,311– 6,759
Early Stonehead	1	1	13,374	13,374	Sutton's Earliest	2	2	5,243	5,231– 5,255
Early Summer	1	1	14,374	14,374	Sutton's Favorite	2	2	1,367	1,355– 1,379
Early Winnigstadt	2	2	8,233	6,594– 9,873	Sutton's Flower of Spring	2	2	778	0– 778
Enkhuizen Glory	2	3	14,827	13,000–16,436	Sutton's Maincrop	2	2	178	0– 178
Golden Acre	3	9	10,778	6,635–15,129					

TABLE 14.—*Showing the average yield per hectare of the fifteen highest yielding cabbage varieties*

Variety name	Number of stations where tes s made	Number of tests made	Average yield per hec are	Range in yield per hectare
			Kilos	*Kilos*
Special Succession	2	2	23.239	16,388–30,091
Succession	4	12	20,224	13,322–48,009
Late Flat Dutch	2	4	18,043	13,178–24,633
Allhead Early	3	7	17,840	5,218–38,578
Allhead Select	1	1	17,230	17,230
Charleston Wakefield	3	11	15,400	9,918–25,707
Surehead	2	3	15,376	13,521–18,315
Premium Flat Dutch	2	3	15,345	7,055–19,939
Shanghai	1	1	15,102	15,102
Enkhuizen Glory	2	3	14,827	13,000–16,436
All Seasons	1	1	14,560	14,560
Early Summer	1	1	14,374	14,374
Autumn King	2	2	13,877	12,672–15.081
Early Stonehead	1	1	13,374	13,374
Stein's Flat Dutch	2	2	13,102	11,400–14.803

Special Succession.—This variety gave the highest average yield based on two tests in two stations, Central Experiment Station and the Los Baños Economic Garden. The yield ranged from 16,388 to 39,091 kilograms per hectare giving an average of 23,239 kilograms. This variety is very similar to Succession (Plate 2), medium early and a sure cropper. The head is solid, but the core is generally long.

Succession.—One of the best among those tested. It has an average yield of 20,224 kilograms per hectare based on 12 cultures in 4 stations; the range in yield was from 13,322 to 48,009 kilograms per hectare. This variety is medium early, maturing in 80 to 120 days depending upon the season. The head is comparatively solid (Plate 3). It has a very wide range of adaptability, and has been found to be good as a main crop as well as for early and late planting.

Late Flat Dutch.—A heavy yielder but rather late, about two weeks later than Succession. The plant is characterized by numerous spreading leaves. Specially adopted for main cropping during the cool months of the year. It has a computed average yield of 18,043 kilograms per hectare; the range in yield was from 13,178 to 24,633 kilograms per hectare.

Allhead Early.—This variety was tested seven times in 3 stations and gave an average yield of 17,840 kilograms per

hectare; the range in yield was from 5,218 to 38,578 kilograms. The head is medium to large and is fairly compact (Plate 4). Medium late and is a good cropper.

Allhead Select.—This was cultured only once and it has shown great promises for lowland culture as compared with Succession and Allhead Early. The head is compact and has neat appearance (Plate 5).

Charleston Wakefield.—This variety was credited with 15,400 kilograms per hectare as average of 11 cultures conducted in 3 different stations. The range in yield was from 9,918 to 20,707 kilograms per hectare. Medium early and is a constant producer. This is the best yielder among the heart-shaped varieties (Plate 6).

Surehead.—Tested three times in 2 stations with production ranging from 13,521 to 18,315 kilograms per hectare. The average of the three tests was 14,376 kilograms per hectare This is a sure cropper with heads of medium size that are fairly compact (Plate 7).

Premium Flat Dutch.—This variety has been tested three times in 2 stations. The plant is big and rather leafy. Its average yield was 15,345 kilograms per hectare and the range was from 7,055 to 19,939 kilograms. The head is big but rather spongy. A heavy cropper when planted during the cool months. It matures in about 1½ to 2 weeks later than Succession.

Shanghai.—Tested only once and at the Central Experiment Station. This variety is commonly grown in Baguio and Trinidad Valley during the rainy months because of its pronounced ability to withstand wet conditions of weather and its fair resistance to diseases (1933). A very late variety maturing in 150 to 170 days. At the Central Experiment Station, the average weight of a head was 1.3 kilograms. The percentage heading was only 43 per cent, hence the computed yield per hectare was only 15,102 kilograms. The head is big but generally not solid, coarse and has a very strong cabbage odor.

Enkhuizen Glory.—Has been cultured three times in two stations. It gave an average yield of 14,827 kilograms a hectare, and the range of its yield was from 13,000 to 16,436 kilograms. A very good variety for commercial planting because of its medium sized-heads that are very solid (Plate 9). A medium early maturing variety.

All Seasons.—Has been tested once at the Central Experiment Station. Its average yield was 14,560 kilograms per hectare. A promising variety.

Early Summer.—This variety was tested once and it gave an average yield of 14,374 kilograms a hectare. Rather leafy with medium sized-heads, and matures about a week later than Succession.

Autumn King.—This has been tested two times in 2 stations. Its yield varied from 12,672 to 15,081 kilograms per hectare with an average of 13,877 kilograms. This variety is promising and is included among those for further testing. The eating quality is good and the core is small in proportion to the head (Plate 10).

Early Stonehead.—This is one of the latest varieties tested that was found promising. The yield was only 13,374 kilograms to the hectare, but its quality was very good, and the appearance of the head very inviting. The head is solid, with very little core (Plate 11).

Stein's Flat Dutch.—This was cultured once in 2 stations with yield ranging from 11,400 to 14,803 kilograms. Its average yield was 13,102 kilograms per hectare. A medium early maturing variety with heads of medium size and fairly compact (Plate 12).

Other varieties that are worth mentioning although not among the 15 best yielders are Golden Acre, Henderson Premier, and Early Market. These are early varieties maturing in 60 to 70 days with small-sized heads that are solid and of excellent eating qualities. They are very good for home gardens. The plants are small with few loose leaves and therefore could be planted closer together.

SUMMARY AND CONCLUSIONS

This paper embraces a study covering a period of five years, 1932–1937, inclusive. A total of 33 varieties has been tested: 8 varieties tested in one station; 17 in two stations; 7 in three stations; and 1 variety in four stations. Eight varieties were tested once only; 9 varieties two times, 5 three times, 3 four times, 3 five times, 2 seven times, 1 nine times, 1 eleven times, and another variety for twelve times.

Of the 33 varieties tested, 15 gave average yields ranging from 14,827 to 23,239 kilograms per hectare, namely Special

Succession, Succession, Late Flat Dutch, Allhead Early, Allhead Select, Charleston Wakefield, Surehead, Premium Flat Dutch, Shanghai and Enkhuizen Glory. The corresponding average yields of these varieties were 23,239, 20,224, 18,043, 17,840, 17,230, 15,400, 15,376, 15,102, and 14,827 kilograms per hectare.

While not all the varieties in this study were tested in the different stations, from the results thus far obtained it was evident that the varieties found best yielders in one station were not necessarily the best in other stations as will be shown later. Nevertheless, there were a few varieties that were included among the best in all stations like Succession.

At the Alabang Rice Station, the best varieties were Succession, Copenhagen Market, and Early Market. Their corresponding yields were 21,470, 18,816 and 14,896 kilograms per hectare. These varieties matured from 80 to 106 days and had a heading of from 97 to 98 per cent.

Out of 19 varieties tested at the Los Baños Economic Garden, Los Baños, Laguna, the five best yielding varieties as a result of three tests were Premium Flat Dutch, Late Flat Dutch, Surehead, Succession and Enkhuizen Glory. Their corresponding average yields were 19,939, 18,905, 18,315, 17,222 and 16,431 kilograms per hectare.

The heaviest yielding varieties found at the Lipa Coffee-Citrus Station out of 10 varieties tested were Succession, Allhead Early, Charleston Wakefield, Early Jersey Wakefield and Golden Acre. The average yields of these varieties were 35,240, 28,733, 21,364, 16,920 and 15,009 kilograms per hectare, respectively.

At the Central Experiment Station, Manila, where 31 varieties were tested from one to six times, the best varieties with respect to yield per unit area were Special Succession, Late Flat Dutch, Succession, Autumn King and Charleston Wakefield. The corresponding yields of these varieties were 30,091, 17,180, 16,513, 15,081 and 14,078 kilograms per hectare.

In some stations like the Los Baños Economic Garden and the Lipa Coffee-Citrus Station, the varieties found best for early planting were as a rule, the best for late planting. In Lipa, the best yielders in the 1933–1934 vegetable season were Succession, Allhead Early, Charleston Wakefield and Early Jersey Wakefield in both the early and late planting (see Table 3).

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ILLUSTRATIONS

PLATE 1

Acclimatization plots at the Lipa Coffee-Citrus Station, Lipa, Batangas. The plots were protected by improvised windbreak made of coconut leaves.

PLATE 2

Special Succession cabbage: *1*, A typical plant with head; *2*, head, side view; *3*, head, top view; *4*, head, longitudinal section; and *5*, head, cross-section. Note the rather long core in *4*.

PLATE 3

Succession cabbage: *1*, A typical plant with head; *2*, head, top view; *3*, head, cross-section; *4*, head, longitudinal section; and *5*, head, lateral view. Note the compact head in *4*, and the rather long core.

PLATE 4

Allhead Early cabbage: *1*, A typical plant with head; *2*, head, lateral view; *3*, head; top view; *4*, head, longitudinal section; and *5*, head, cross-section. Note the rather long core and the comparative uniform compactness of the head.

PLATE 5

Allhead Select cabbage: *1*, A typical plant with head; *2*, head, lateral view; *3*, head, top view; *4*, head, longitudinal section showing the compact nature on top and the rather loose lower portion; and *5*, head, cross-section.

PLATE 6

Charleston Wakefield cabbage: *1*, A typical plant with head; *2*, head, lateral view; *3*, head, top view; *4*, head, longitudinal section; and *5*, head, cross-section. Note the pointed head as seen in *2*, and *4*, and its compactness as seen in *4* and *5*.

PLATE 7

Surehead cabbage: *1*, A typical plant with head; *2*, head, top view; *3*, head, cross-section; *4*, head, side view; and *5*, head, longitudinal section. Note the compact nature at the upper portion, and the looseness of the lower portion.

PLATE 8

Premium Flat Dutch cabbage: *1*, A typical plant with head; *2*, head, longitudinal section; *3*, head, side view; *4*, head, cross-section; and *5*, head, top view.

PLATE 9

Enkhuizen Glory cabbage: *1*, A typical plant with head; *2*, head, side view; *3*, head, top view; *4*, head, longitudinal section of head; and *5*, head, cross-section. Note the very compact nature of the head in *4* and *5*.

PLATE 10

Autumn King cabbage; *1*, A typical plant with head; *2*, head, side view; *3*, head, top view; *4*, head, longitudinal section; and *5*, head, cross-section. Note the short core in *4*.

PLATE 11

Early Stonehead cabbage: *1*, A typical plant with head; *2*, head, side view; *3*, top view of head; *4*, longitudinal section of head; and *5*, head, cross-section. Note the small-sized core in *5*.

PLATE 12

Stein's Flat Dutch cabbage: *1*, A typical plant with head; *2*, head, lateral view; *3*, head, top view; *4*, head, longitudinal section; and *5*, head, cross-section. Note the long core in *4*.

PLATE 13

Early Winnigstadt cabbage: *1*, A typical plant with head; *2*, head, lateral view; *3*, head, cross-section; *4*, head, longitudinal section; and *5*, top view. Note the long core and looseness of the head in *4*.

PLATE 14

Danish Ballhead cabbage: *1*, A typical plant with head; *2*, head, lateral view; *3*, head, top view; *4*, head, longitudinal section; and *5*, head, cross-section.

PLATE 1.

PLATE 2.

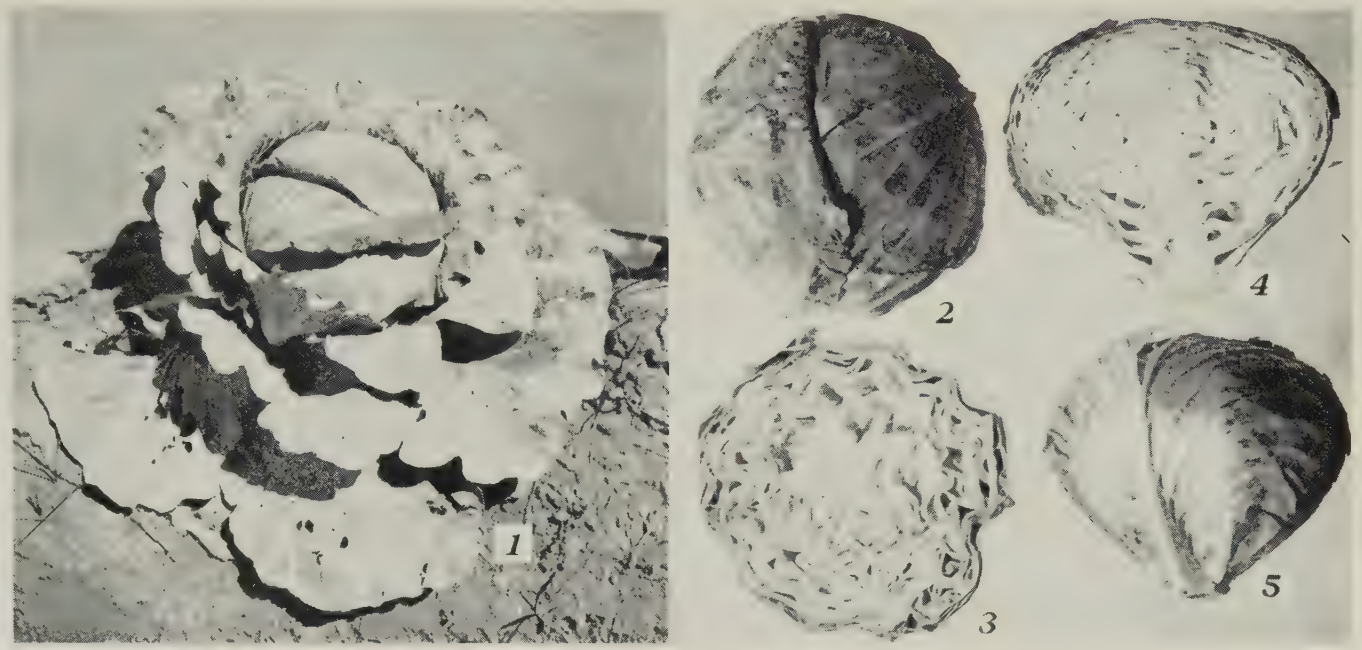


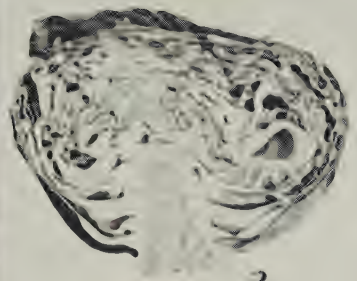
PLATE 3.

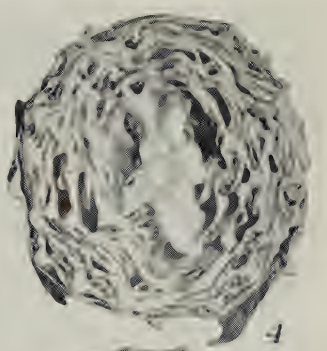
PLATE 4.

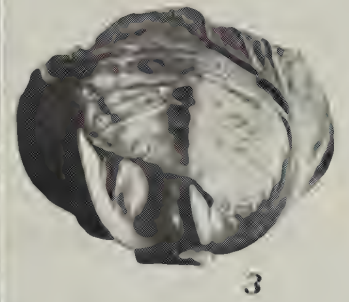
PLATE 5.

PLATE 6.

PLATE 7.







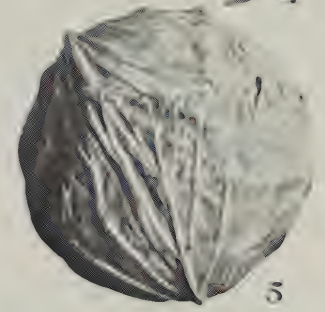


PLATE 5

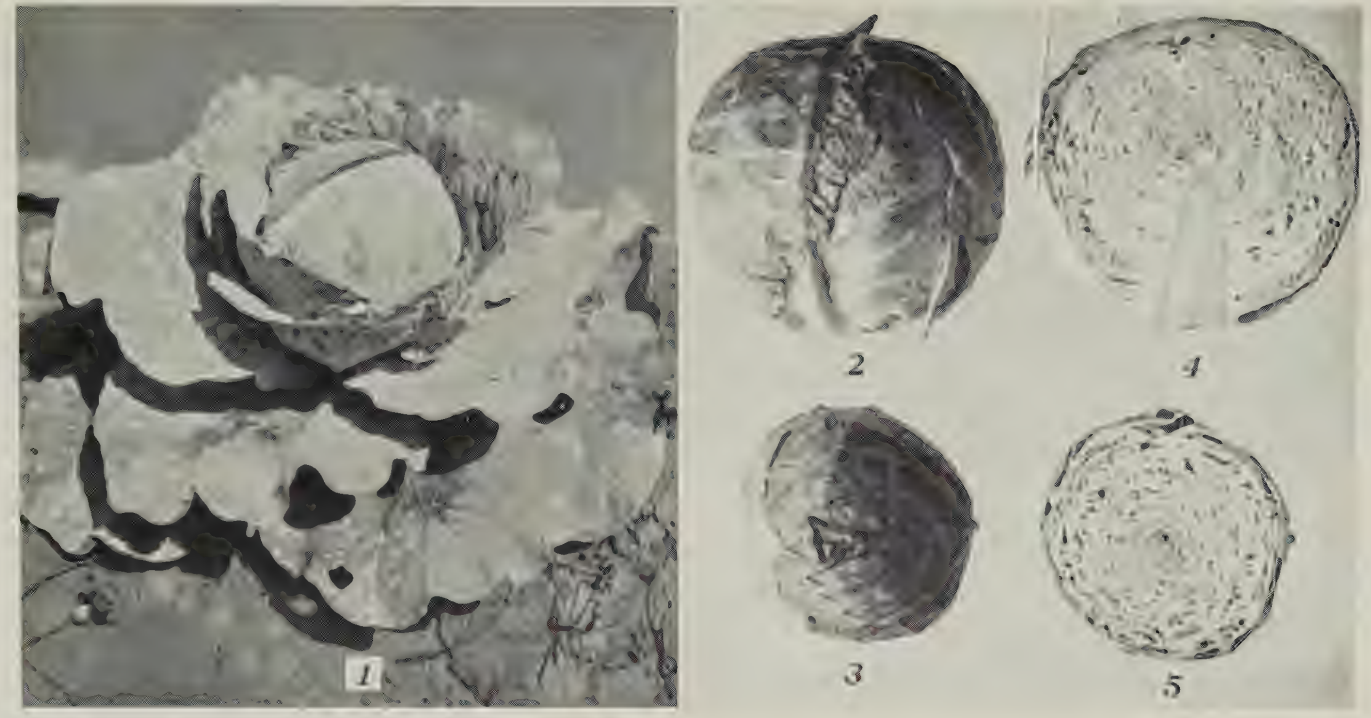


PLATE 9.

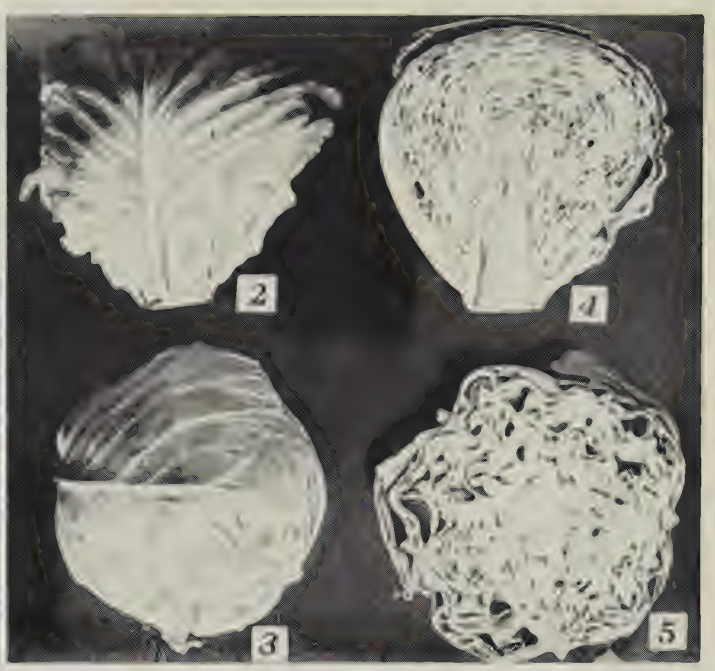


PLATE 10.

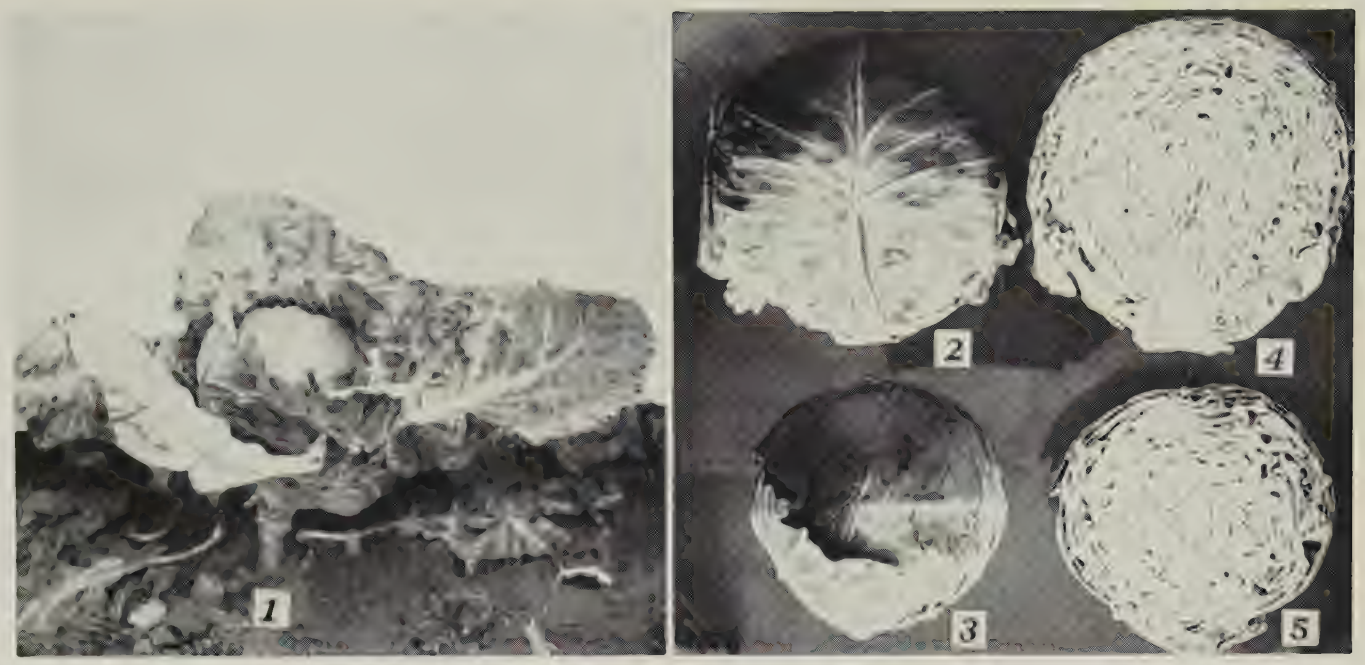


PLATE 11.

PLATE 12.

PLATE 13.

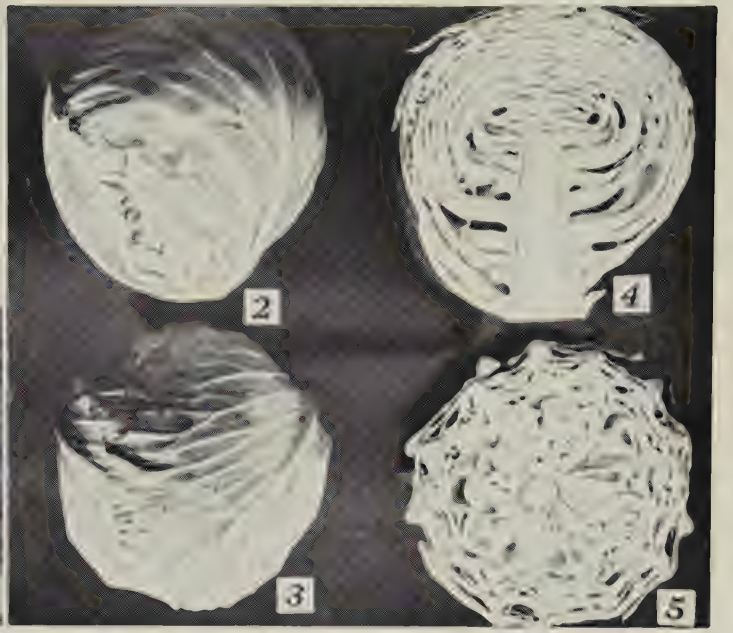


PLATE 14.

A REPORT ON THE PRESENCE OF THE COCONUT ZYGAENID, ARTONA CATOXANTHA HAMPS, IN THE PROVINCE OF PALAWAN

By Gonzalo Merino

Of the Bureau of Plant Industry

ONE PLATE

The coconut zygaenid moth, *Artona catoxantha*, Hamps, of the family Zygaenidæ, a very destructive pest of coconut heretofore not reported in the Philippines, has been found to infest coconut groves in Palawan.

The first report about this pest was received early in 1927. The groves infested being located in Iwahig Penal Colony, Puerto Princesa, that is, in the middle section of the island of Palawan. This infestation was immediately placed under control by having the infested fronds cut and burned. In 1931, however, the pest reappeared in the same place and similar control measure was adopted. Simultaneously the pest appeared in the barrio of Tandayag, about 20 miles away from Iwahig Penal Colony, Puerto Princesa, in the coconut groves of Messrs. Manalo and Fernandez. Since then the owners and the tenants, under the direction of the plant inspectors of the Bureau of Plant Industry, have been fighting it by spraying the leaves with calcium arsenate solution and burning the fronds. When the writer visited the infestations at Tandayag and Maruyogon about the middle of March of 1937, the insects were fast emerging from the pupal cases. Burning of the infested fronds was still being employed. Fortunately two days after, there was quite a strong gale followed by torrential rains within the areas infested. These adverse weather conditions apparently caused a high mortality, that up to this time no further recurrence of the pest in those localities has been reported.

The range of infestation during the inspection trip of the writer was on the coast line from the barrio of Tandayag to the sitio of Maruyogon on a strip of land about three-fourth of a kilometer wide and 8 to 10 kilometers long, infesting over

10,000 trees of the 27,000 coconut trees in a solid grove of Messrs. Manalo and Fernandez, and about 2,000 other trees on irregularly planted groves on the sea coast up to Maruyogon, the opposite sides of the plantations are forested areas.

On his return to Manila, the writer sent specimens of the adult moth and larvæ to Dr. P. Van der Goot, Institute of Plant Disease, Buitenzorg, Java, for verification. Dr. Van der Goot, confirmed our identification of the insect as *Artona catoxantha*, Hamps.

DESCRIPTION OF THE INSECT AND MODE OF ATTACK

The adult moth is dark-brown or almost black in color above. It has a wing expanse of about 15 millimeters, the tips of the wings are fringed and light yellow ventrally, including the legs. The caterpillar is slug-like because of the rows of glandular hairs on the dorsal segment of the larva. When newly hatched, it is palish green and somewhat translucent. As it becomes older the color changes to greenish-yellow with dirty brownish-black stripe on the middle dorsal and with irregular marking on the marginal side of the same. Fully-grown larvæ attain the length of about 10 millimeters. It is the larva that causes injury on the under side epidermis of the leaflet, by eating longitudinal transparent slits, causing the entire frond to turn brown and dry up. The attack is generally found on the mature fronds which causes them to fall. Thus the immature nuts also fall off causing great losses to the coconut planters because of reduced crop harvested and because of delayed production. It is true that the coconut trees are not killed, but the health of the infested trees is greatly affected and the losses of immature nuts are very evident.

The eggs are laid singly on the under side of the pinnæ in irregular batches slightly oval almost cylindrical in form but flattened, about $\frac{1}{2}$ of a millimeter in length, the cocoon are spun by the larvæ mostly on the under side of the coconut leaflets. Many cocoons were found on the side of the stem of the fronds. They are white, flat and elliptical in shape about 10 to 11 millimeters long and about 5 to 6 millimeters wide.

The pupa is pale green to light yellow, about 7 millimeters in length, becoming darker as it gets older and more so before the moth emerges, when it assumes the color of the adult moth.

HABITS AND ECONOMIC IMPORTANCE

This insect is considered by Dammerman [1] as a destructive pest of coconut and is known in the Malay Peninsula as "ulat hantu kail" or "ulat gantong." Because of their feedings, the larvæ cause longitudinal patches on the under side of the pinnæ which have the characteristic of batches similar to the attack of the adult coconut leaf miner and some slug caterpillars, only they are wider, as illustrated herewith. The attack starts on mature fronds beginning from the outer most frond to the younger ones. When the attack is quite severe the infestation reaches even the youngest fronds. The attacked fronds wither quickly and later hang or droop down. Then the falling of immature nuts follow. In many cases, the dropping of the young-nuts become total causing a severe setback to the production of the trees and impairing the health of these considerably. There has been, however, no cases of trees killed from the attack, but it is presumed, that severely attacked trees may not produce normally until after two years.

The adult insects become sexually mature one day after emergence as evidenced by their copulating propensities after that time. They fly around in the open and alight on any hanging leaves or objects on a semi-erect posture as shown in plate 1(*d*). During such infestation, it was observed that they are not attracted to Dietz lamps placed out in the open at night, neither were they observed to approach bonfires built in an open copra dryer.

RANGE OF DISTRIBUTION

This insect has never been mentioned in any literature at present in the Philippines. I am now, therefore placing the Province of Palawan within the range of distribution of this pest. According to Tothil *et al.*[2] the range of distribution are as follows: Malaya, Sumatra, Java, Borneo, Labuan, and Tenasserim. It is possible that Palawan Island is within the distributional center. According to Dickerson *et al.*,[3] Palawan and

[1] Dammerman, W. K. Agric. Zoö. of the Malay Archipelago, p. 149.

[2] The coconut moth in Fiji, Imperial Bureau of Entomology, p. 211; 1936.

[3] Distribution of life in the Philippines, Bureau of Printing pp. 24–25, 28, p. 265.

its dependent islands, that is, the Calamianes, are in the oriental region under the Arctogaeic realm to which region Palawan and the Calamianes with the southern peninsula of Asia, Malay Archipelago including Sunda Islands belong. It is said by the same authors that probably at the period when the Philippines were isolated from the rest of the Malay region, Celebes, Java, Sumatra, Borneo, and Palawan were still connected with each other. For this particular reason the coconut Zygaenid moth, *Artona catoxantha* Hamps may be indigenous or autochthonous to Palawan also. The possibilities of accidental introduction are very remote. In the first place, it could not have been introduced by men as there are no coconut plants ever imported for planting nor for ornamental purposes. Such things are not done, only the coconut seeds being introduced. Neither could it have been blown by wind from North Borneo to the mainland of Palawan as the big infestations became known in the middle section of the island of Palawan instead of the southern extremities.

REPORTED HOST PLANTS

Dammerman (Agric. Zoöl. of the Malay Archipelago, pp. 149–150–(1929), mentions that the coconut Zygaenid moth also attacks other palms such as *Nipa,* Nibong (*Oncosperma*), sago palm, *Areca* and *Calamus.* Tothil *et al.* (the coconut moth in Fiji, p. 211; 1930), gives the following food plants:—*Cocos, Metroxylon, Areca, Phœnix, Oncosperna, Calamus, Nipa.*

NATURAL ENEMIES

The most dominant natural enemies of *Artona catoxantha* in Malaya is a Tachinid parasitic insect, *Ptychomyia remota.* This beneficial insect was once used with success to control the Fiji coconut moth, *Levuana irridescens* which broke out in Fiji Islands early in 1925. Corbett in his Insects of Coconuts of Malaya, pp. 81–82, names another Tachinid fly, *Degeeria albiceps;* two Icheneumonids, *Goryphus maculiceps,* and *G. maculipennis;* a Braconid, *Apanteles artona;* a predator Clerid beetle, *Calimerus areufer* and an entomophagous fungus, *Botrytis necans.* Dammerman (pp. 149–150) gives the following additional natural enemies: A predatory Pentatomid bug, *Canthecona furcellata;* A Braconid, *Microgaster* sp.; An Ichneumonid—*Mesostenus* sp. Tothil *et al.* (p. 213) also mentions, *Euplectrus* sp. an *eulophid* parasite.

With the preserved larvæ I brought from the field, I noticed cocoons of *Apanteles* attached to the ventral side of many of my larval specimens.

CONTROL MEASURES

The control measures applied against the Palawan infestations were burning of the larval and pupal infested leaves, and the spraying with soap and calcium arsenate solutions on the larvæ infested leaves as contact and stomach insecticides, respectively. The complete disappearance of the moths apparently was effected by coincidence of infestations in the adult stage with occurrence of strong winds and torrential rains during the month of March of this year (1937).

ILLUSTRATION

PLATE 1

Fig. 1. *Artona catoxantha* Hamps, male enlarged (wing expanse of specimen about 14 mm.).
2. *Artona catoxantha*, with wings folded (length of specimen from tip of head to tip of wing about 7 mm.).
3. Egg. (length of specimen about 0.5 millimeter).
4. Characteristic attitude of moths.
5. Empty cocoons (length of a cocoon about 11 millimeters).
6. Caterpillar (length about 10 milimeters).
7. Pupa. (length about 7 millimeters).
8. Portion of a coconut leaflet showing injury by caterpillars.

[NOTE.—Figures 1, 3, 4, 5, 6, and 7 were drawn from Corbetts Insects of Coconuts in Malaya, 1932, while figures 2 and 8 are original.]

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PLATE 1.

NOTES ON THE PROPAGATION OF *LONCHOCARPUS NICOU* (AUBL.) DC. BY MARCOTTAGE

By Nicanor G. Teodoro

and

Filemon Q. Abaya

Of the Bureau of Plant Industry

TWO PLATES

On September 22, 1932, six rooted cuttings of "Cube" of Peru, botanically known as *Lonchocarpus nicou* (Aubl.) DC. and belonging to the Leguminosae family, were received at the Economic Garden, Los Baños, Laguna, from the Bureau of Plant Industry of the U. S. Department of Agriculture, Washington, D. C. It may be mentioned in this connection that this plant is a shrub or small tree supposed to be superior to *Derris* as a source of rotenone, a substance of value as an insecticide.

These cuttings were planted first in the nursery where they were observed not to thrive well. In fact two of them died. The four that survived were later potted to insure a better care.

On January 29, 1934, or a year after potting, believing that they were already safe for transplanting, they were set in the Leguminosæ section within the Systematic Field. After some time, however, only two plants remained alive.

It was thought necessary to multiply the surviving plants, and realizing that they are delicate, the writers have resorted to marcotting a branch from one of the mother plants which has attained a height of about 1.2 meters. In the marcotting operation the junior writer made the following process:

On April 28, 1937, the branch selected for the purpose was girdled at a convenient point to about 2 centimeters in length as indicated in Plate 1, fig. 1. The bark of the girdled section was removed and the cambium layer scrapped off with a budding knife, the purpose being to prevent the wound from healing during the callousing period.

On May 27, 1937, or about a month after the removal of the bark, when the wound has calloused, coconut fiber containing equal parts of ordinary garden soil and horse manure, was tied

around and over the debarked portion as shown in Plate 1. Just above this point there were tied two tin cans (Plate 2, fig. 1), having tiny perforations at the bottom, which were constantly filled with water whenever necessary, the purpose being to keep moist the medium for rooting.

On July 5, 1937, some roots were observed penetrating through the coconut fiber, and 8 days thereafter when sufficient number of roots (Plate 2, fig. 1) were formed, the branch was cut, as usual for any marcotted branches, and planted in a big earthen pot (Plate 2, fig. 2). The rooting medium was not removed but allowed to remain with the potted plant. This plant is kept in the nursery shed for a few weeks, or until it has a thoroughly established root system.

ILLUSTRATIONS

PLATE 1

A 4-year old *Lonchocarpus nicou* (Aubl) DC. showing (1) two branches, one of which (left) was marcotted, (2) a close-up view of the marcotted branches.

PLATE 2

The same plant showing (1) the marcotted branch severed from the mother plant, (2) the same branch planted in an earthen pot to insure better care, etc.

PLATE 1.

PLATE 2.

A REPORT ON PHILIPPINE BIRDS THAT PREY ON THE ORIENTAL MIGRATORY LOCUST (*LOCUSTA MIGRATORIA MANILENSIS* MEYEN)

By Pablo S. Soriano

Of the Plant Pest and Disease Control Division, Bureau of Plant Industry

SEVEN PLATES

In the control of the Oriental migratory locust (*Locusta migratoria manilensis* Meyen), it has been deemed advisable to secure as much information as possible on birds that prey on the insect so that at least those that are found to be most valuable in this respect might be protected and their multiplication, if possible, encouraged, as a part of the national policy of bird protection and conservation. Reliable information on this subject can, of course, only be secured by carefully examining the contents of the stomachs of birds caught from locust infested areas.

This paper aims to present the data that have been observed so far as a basis for further work, the value of which hardly needs any comment, for it is only from the information obtained in a study of this kind that laws for the protection of certain birds can be logically and properly based. It is needless to state that bird protection and conservation should be based not on sentimental grounds and on casual observations but on definite information on the food habits of such birds, obtained from careful examination of the stomach contents of as many of such birds as could be caught or shot.

MATERIALS

Some of the materials used in this study were taken from the municipalities of Rizal, Laguna and Lemery, Batangas, in 1935 when locusts invaded these places. The rest were taken from Sta. Rita, Samar and from Ormoc, Baybay and Albuera, Leyte, in 1936, when the writer was assigned to these places in connection with locust control work.

The above-mentioned towns in Samar and Leyte were coastal towns. Behind them, for distances ranging from 3 to 7 kilometers, are mountain ranges covered with thick verdant forest. At the foothills, there are trees and shrubs growing abundantly.

In some places below the foothills there are scattered tall trees spared by the homesteaders and it is in these places where the birds of prey used to haunt. Between these places and the coast, are plains where sugar cane, rice, corn, etc., are extensively cultivated and it is in these places where birds, dwellers of open country, are found. It should be stated that the birds collected from these places represent different species living in different strata as regards to type of vegetations and climatic conditions.

METHODS OF STUDY

Field observation of the food habits of birds, although it is useful, is far from being accurate. For example, there are birds found in fruit trees and they have been accused of feeding on the fruits when in fact they do not feed on such fruits. This is also true to the contrary. In order to be more accurate and reliable, stomach examination is necessary. Having this in mind, the writer shot birds representing the different species found in the locust infested areas.

The numerical method has been used in this study, for the writer believes that the amount of injury or benefit that a bird gives depends upon the number of destructive or beneficial animals or crops it destroys.

The insects and other food items in each stomach were counted. If the food had been partially digested, the number of paired mandibles of locust found in the stomach was taken to represent the number of locust taken; the number of paired elytra meant the number of beetles; the number of snouts showed the number of weevils. Any unpaired elytron or mandible was considered as representing one insect.

The percentage was taken by dividing the number of insects or seeds belonging to a certain family or genera or species, as the case may be, by the total number of food items in the stomach and then multiplied by 100. For example, if there are 10 locusts found in the stomach and the total number of food items including the 10 locusts is 100, divide 10 by 100 and then multiply by 100 to get the percentage of locust which is 10 per cent.

RESULTS AND DISCUSSION

In order to give a more comprehensive description of the results obtained, it is deemed proper to indicate other pertinent facts about the birds found to feed on the insect. The vernacular and scientific names were supplied by the Bureau of

Science while the distribution is based on the book, A Manual of Philippine Birds by Richard C. McGregor.

Vernacular names available within the reach of the author are given under each species with the hope that a Filipino reader may have an idea or knowledge of the birds under discussion.

WATERCOCK, Gallicrex cineria (Gmelin). Plate 1, fig. 2.

This bird is called Tubtub in Ilocos, Bicol and Ticao; Cannutok, Manila; Tapayan, Cebu; Tuyud, Bohol; Tugtug, Masbate.

This species is found throughout the Philippine Islands.

It is abundant in rice fields and marshes in some localities. It walks and it has the gait of our domestic chicken. When an enemy approaches, it walks away, always keeping an eye on the enemy. It nests in the rice field and, when it does, it builds its nest out of the rice plants, thus destroying them.

Two birds were shot in Ormoc, Leyte, and their stomach contents examined. There were found 3 locusts, which made up 0.4 per cent of the food contents; 1 katydid, 1 cricket and 1 weevil, 0.4 per cent; 5 unidentified insects and snails, 0.7 per cent; 688 weed seeds which made up 98.4 per cent of the entire stomach contents.

PHILIPPINE ASHY CRAKE, Poliolimnas cinereus collingwoodi Mathews.

This bird is called Toclin in Ilocos; Tighik, Cebu; Ticling, Tica, or Matang bayani, Tagalog.

It is common among the grasses and reeds about lakes, marshes and creeks. It walks and has the gait of a domestic chicken. It builds its nest in the tall grasses and bushes.

The only bird shot in Ormoc, Leyte, showed in its stomach 7 locust hoppers, or 87.5 per cent of the contents, and 1 darkling beetle, 12.5 per cent.

INDIAN CATTLE EGRET, Ardeola ibis coromanda (Boddaert). Plate 1, fig. 1.

This species is called Cannaway in Ilocos and Pangasinan; Tagac, Tagalog and Pampango; Talabon, Talabong, Tabon, or Tabong, Eastern Visaya; Talaud, Bicol; Taguak, Calayan.

It is found throughout the Philippine Islands.

This bird is sometimes seen either singly or in pairs, but mostly in flocks of over hundred individuals. They are usually found in wet fields, marshes and along lakes, ponds and creeks. Birds are at times seen on the back of carabaos. When the bird flies, the neck is withdrawn and the long legs are extended backward, appearing to be like a tail. Sometimes a flock or

flocks in military formation are seen hovering over rice fields. It breeds in marshes.

Two stomachs taken in Lemery, Batangas, were examined and found to contain 44 locusts, 50 per cent of the food contents; 18 crickets, 20 per cent; 3 katydids, 3 per cent; 5 grasshoppers, 6 per cent; 12 spiders, 14 per cent; 6 unidentified insects, 7 per cent.

It has been observed that this bird feeds voraciously on locust. Due to its big size and the great number of individuals in a flock, doubtless a flock can consume lots of locusts in a day. Some local officials like those of Palo, Leyte, Cotabato, Cotabato and others, recognize this and in return to the great help this bird renders in the suppression of locust infestation and other insect pests, they passed ordinances prohibiting the catching and killing of this species.

It has also been observed that this species prey at times on fishes, crustaceans and amphibians, but not to a considerable extent.

TIC-WEE BUZZARD, Butastur indicus (Gmelin). Plate 2, fig. 1.

This species is called Limbas in Tagalog; Tic-wee, Ilocos and Eastern Visaya; Cuyab, Calayan.

It is found throughout the Philippine Islands.

It is common. It is either seen singly, in pairs or in flocks. It is usually found in places where there are few tall trees in an open field. Being a bird of prey, the tall trees serve as good vantage points for its lookout. It nests in tall trees.

The three stomachs collected in Ormoc, Leyte, contained 59 locust flyers, 98 per cent of the food contents; 1 unidentified insect, 2 per cent. These were the birds seen catching locust flyers in a swarm.

This bird has been observed taking flyers on the wing either with its bill or its claws, but mostly with the latter. When it takes a locust flyer with its bill, it usually alights in a nearby tree where it devours the victim; when it takes one with its claws, it usually devours it in the air.

Flocks of this bird sometimes serve as a good guide for locust scouters in the location and direction of flights of locust swarms. When a flock is seen hovering at a distance (a distance that the swarm of locust flyers is not visible to the naked eye) and the birds dart now and then, it is a sign that a swarm of locust flyers is being followed by the flock.

This species has been seen taking chicks and chasing small birds.

MALAYAN BRAHMING KITE, Haliastur indus intermedius Gurney. Plate 2, fig. 2.

This bird is called Kali in Ilocos; Lawin, Tagalog; Banog, Eastern Visaya; Baga, Pangasinan.

It is found throughout the Philippine Islands.

It is seen either singly, in pairs or in flocks. Flocks are usually found together with those of the Tic-wee buzzard in ports and along the coasts where there are many fishermen, for they feed on dead fishes purposely thrown away during sorting and incidentally during unloading, and refuses thrown overboard from ships. It is seldom found far inland.

One bird was shot in Ormoc, Leyte, and its half-filled stomach contained 7 locust flyers, the only food contents. This bird was busy taking flyers when it was shot. If allowed to continue, it would have taken more perhaps. Like the Tic-wee buzzard, a flock serves as a good guide for locust scouters to locate the swarm of locust flyers and determine its direction.

This bird was seen taking snakes and chasing small birds.

BROAD-BILLED ROLLER, Eurystamus orientalis orientalis (Linneaus). Plate 4, fig. 2.

This species is called Loro inchik in Tagalog; Langas, Cagayancillo; Tagalas, Calayan; Salaksakan, Ticao; Salak, Leyte; Balisaksak, Negros Oriental.

It is found throughout the Philippine Islands.

This bird is not so common. It is usually seen singly perching quietly on dead branches of trees where it could have a good lookout. It takes its prey on the wing and usually returns to the same perching place where it devours or swallows, depending upon the size of the victim.

There were two stomachs taken, one in Sta. Rita, Samar and the other in Albuera, Leyte, and they contained 3 locust flyers, 27 per cent of the food contents; 2 katydids, 18 per cent; 2 hemiptera, 19 per cent; 1 June beetle, 9 per cent; 3 unidentified insects, 27 per cent.

WHITE-COLLARED KINGFISHER, Halcyon chloris collaris (Boddaert). Plate 5, fig. 6.

This bird is called Salaksak in Ilocos; Kasaykasay, Tagalog; Ticarol, Eastern Visaya; Batala, Pampango; Salaksakan, Iloilo; Barita, Bicol; Bakaka, Samar and Leyte; Takarit, Ticao; Takray, Panay.

It is found throughout the Philippine Islands.

It is very common, especially along wooded streams, mangrove swamps and seashores. At times it is seen darting into the water to get its prey. It is seen either singly or in pairs.

It is noisy during mating season which takes place in the months of May and June.

One stomach taken in Sta. Rita, Samar, contained 8 locust flyers, the only food contents.

It has been observed that this bird takes fishes, reptiles, crustaceans and amphibians.

WHITE-THROATED KINGFISHER, Halcyon smyrneulis gularis (Kuhl). Plate 5, fig. 4.

This species is called Tigmamanok in Tagalog; Bakaka, Samar and Leyte; Salaksakan, Negros Oriental; Salaksak, Ilocos.

It is found throughout the Philippine Islands.

It is usually found among the trees and shrubs along freshwater streams. It is either seen singly or in pairs. Like the white-collared kingfisher, it is noisy during mating season which takes place in the months of May and June. It breeds mostly along river banks.

The stomach taken in Baybay, Leyte, was almost empty. It contained 1 locust flyer, 50 per cent of the food contents; 1 unidentified insect, 50 per cent.

Like the white-collared kingfisher it has been observed taking fishes, crustaceans and amphibians.

SAMAR TARIKTIK, Penelopides panini samarensis (Steere). Plate 3, fig. 1.

This bird is called Tariktik in Ilocos and Tagalog; Taosi or Talusi, Bohol, Samar and Leyte.

It is found only in the Provinces of Samar, Leyte, and Bohol, Philippine Islands.

It is seen singly but frequently either in pairs or in groups. It is a tree dweller. It is noisy and of heavy flight.

There were three stomachs collected in Ormoc, Leyte, and they contained 3 locust flyers, 25 per cent; 1 unidentified insect, 8 per cent; 4 June beetles, 33 per cent; 4 seeds of wild fruit trees, 34 per cent.

GREEN-HEADED BEEBIRD, Merops superciliosus philippinus Linneaus. Plate 6, fig. 8.

This bird is called Pirpirio in Ilocos; Parikparik or Pirik, Tagalog; Purokpurok, Eastern Visaya; Patiriktirik, Pampango, Pilio, Negros Oriental.

It is found throughout the Philippine Islands.

This bird is seen in pairs but mostly in flocks. It is usually found in open places. It perches where it can have a good outlook of the surroundings. Telegraph posts and lines are good vantage points where it ordinarily scans the ground for a prey.

It seems that trees and shrubs could not adequately supply for a lookout. From its perching place, it flies then soars and then glides to the same or other perching place and it does this several times with its characteristic note "piriw, piriw, piriw." It nests in colonies in sandy steep banks.

The four stomachs collected, one in Rizal, Laguna and the others in Ormoc, Leyte, contained 3 locust flyers, 19 per cent of the food contents; 1 katydid, 6 per cent; 1 carrion beetle, 6 per cent; 1 long-horned beetle, 6 per cent; 6 hymenoptera, 37.5 per cent; 4 unidentified insects, 25 per cent.

This bird takes locust flyers on the wing with its bill. After it has taken one it goes to perch, kills the victim by bumping it on the perch and then swallows it.

RED-WINGED COUCAL, Centropus viridis (Scopoli).

This bird is called Cacuk in Ilocos; Sabucot or Saguksuk, Tagalog; Cucuk, Eastern Visaya; Siabukut, Pampango; Saguksuk, Western Visaya and Bicol.

It is found throughout the Pilippine Islands.

It is a solitary bird and commonly found in bushes and tall grasses in the open country. It is heavy on its flight and it does not fly high and far. When it is scared and pressed, it flies and then dives into the grasses where it can make a good escape from its enemy. It nests mostly in tall grasses.

There were two stomachs taken, one in Sta. Rita, Samar and the other in Ormoc, Leyte, and they contained 6 locust flyers, 86 per cent of the food contents; 1 grasshopper, 14 per cent.

JAVAN COUCAL, Centropus bengalensis javanensis (Dumont). Plate 4, fig. 1.

This bird is called Cacuk in Ilocos; Sabucot or Saguksuk, Tagalog; Cucuk, Eastern Visaya.

It is found throughout the Philipine Islands.

Its habit is similar to that of the red-winged coucal.

The only stomach taken in Ormoc, Leyte, contained two locust flyers, the only food contents.

COMMON SWALLOW, Hirundo rustica guttoralis Scopoli. Plate 6, fig. 2.

This bird is called Sal-lapiñgao in Ilocos; Layanglayang or Lañgaylañgayan, Tagalog, Balinsasayao or Sayao, Eastern Visaya; Sibad, Pampango.

This species is found throughout the Philippine Islands.

It is seen in open places in flocks which are sometimes composed of over hundred individuals. It usually alights on places

where it can have a good outlook of the surroundings for it takes its prey mostly on the wing. It is sometimes seen in towns flying low and fast zigzagly through thoroughfares even if there are plenty of people. During cloudy days at the approach of rain, several are seen flying unsteadily at random above grasses in open field and above the houses in towns. It nests in caves and abandoned houses. The nest is made of mud attached to rocks and beams.

There were three stomachs taken in Ormoc, Leyte and they contained 39 locust hoppers of the second and third stages, 67 per cent of the food contents; 1 June beetle, 2 per cent; 6 weevils, 10 per cent; 1 homoptera, 2 per cent; 2 hemiptera, 3 per cent; 7 hymenoptera, 12 per cent; 2 unidentified insects, 3 per cent.

By nature this bird takes its prey on the wing, but it also takes its victim on the ground when it finds it convenient. The writer has observed this species taking hoppers by flying low over them and snapped one hopper as it jumped when it was scared by its approach. It was also observed alighting on the ground to pick the hoppers. Being a small bird, it could take chiefly hoppers of the first, second, and third stages.

KOCK'S ARTAMIDES, Coracina striata kochi (Kutter). Plate 5, fig. 2.

This species is called Kiakia in Leyte; Baboybaboyan, Novaliches, Rizal.

It is found throughout the Philippine Islands.

It is usually found in trees in the foothills.

The only stomach taken in Ormoc, Leyte, was almost empty; it contained only 1 locust flyer, 50 per cent of the food contents; 1 June beetle, 50 per cent.

GUAVA BULBUL, Pycnonotus goiavier goiavier (Scopoli). Plate 6, fig. 1.

This species is called Luklak, Pulañgo, or Kalaga in Tagalog and Pampango; Piroca, Ilocos; Curao or Culcul, Cebu; Parago or Palogo, Samar and Leyte; Agol-ol, Misamis.

This bird is found throughout the Philippine Islands.

It is common in fruit trees, bushes and shrubs in the plains, but not in deep forests. It is often seen in pairs, but also in flocks in a tree bearing plenty of fruits which they relish. It nests mostly in bushes and shrubs.

The only stomach taken in Rizal, Laguna, contained 11 locust hoppers, the only food contents.

PIED CHAT, Saxicola caprata caprata Linneaus. Plate 6, fig. 3.

This bird is called Sipao, Taing baboy, or Tererekoy in Tagalog; Maria capra, Pampango.

It is found throughout the Philippine Islands.

It is usually found either singly or in pairs in shrubs and grasses where it can have a good outlook in the open country. It is restless, always spreading and jerking its tail when it is perching.

The stomach taken in Rizal, Laguna, contained 12 locust hoppers, 50 per cent of the food contents; 1 June beetle, 4 per cent; 2 hemiptera, 8 per cent; 3 hymenoptera, 13 per cent; 6 unidentified insects, 25 per cent. Being a small bird, it could take only hoppers of the first, second and third stages.

GOLDEN-HEADED CISTICOLA Cisticola exilis rustica Wallace. Plate 6, fig. 4.

This bird is called Pipit cogon in Tagalog; Perit or Pirot, Eastern Visaya.

It is found throughout the Philippine Islands.

It is found among the grasses in an open country. It is sometimes seen perching on tall grasses and shrubs. When it is disturbed, it flies in a jerky way to a short distance and then dives among the grasses where it could make a good escape from the intruder.

The stomach taken in Ormoc, Leyte, contained 1 locust hopper, 25 per cent of the food contents; 1 katydid, 25 per cent; 1 grasshopper, 25 per cent; 1 unidentified insect, 25 per cent. Being a small bird, it could take only hoppers of the first, second and third stages.

STRIATED MARSH WARBLER Megalurus palustris forbesi Bangs. Plate 6, fig. 6.

This species is called Tiktikrobong in Ilocos; Sunod kalabao, Tortoriok, or Tintiriok, Tagalog; Trotoriok, Eastern Visaya; Bacabaca, Pampango.

It is found throughout the Philippine Islands.

It is mostly seen either singly or in pairs in tall grasses in the open country. It is very fond of singing and its song has a ventriloquial quality. It is a slow and heavy flyer like the coucal. It walks fast on the ground and hides in patches of grasses or thickets when it sees a person.

The two stomachs taken, one in Ormoc, Leyte and the other in Baybay of the same province, contained 6 locusts, 86 per cent of the food contents; 1 katydid, 14 per cent.

WHITE-BELLIED SWALLOW SHRIKE, Artamus leucorhyncus leucorhyncus (Linneaus). Plate 6, fig. 5.

This species is called Gitgit or Gikgik in Ilocos; Pagatpat, Tagalog; Gitgit, Eastern Visaya; Alo-it-it, Panay; It-it, Misamis.

It is found throughout the Philippine Islands.

It is seen either in pairs or in flocks, and usually perches on coconut fronds, telegraph lines, top of barns or any place where it can have a good outlook of the surroundings, for it gets its prey on the wing. It is aggressive; it drives away any bird that comes nearby; it always chases a crow or a hawk that passes by.

There were two stomachs taken, one in Rizal, Laguna and the other in Sta. Rita, Samar, and they contained 5 locusts, 71 per cent of the food contents; 2 unidentified insects, 29 per cent.

LARGE-NOSED SHRIKE, Lanius schach nasutus (Scopoli). Plate 5, fig. 7.

This bird is called Verdugo in Ilocos; Tarat San Diego, Kamugot, or Cabesote, Tagalog; Verdugo or Ma-mu-muñgat, Eastern Visaya; Tarat bulan, Pampango.

This species is found throughout the Philippine Islands.

It is mostly seen singly in low trees, shrubs, fences and telegraph lines in open country. It usually perches on a vantage point where it can see well the surroundings. It is an aggressive bird, always ready to drive away a bird intruder. It is a slow and heavy flyer, like the striated marsh warbler.

The two stomachs collected, one in Rizal, Laguna and the other in Ormoc, Leyte, contained 20 locust hoppers, 95 per cent of the food contents; 1 unidentified insect, 5 per cent.

This bird has been observed taking small rodents and chasing small birds.

GRAY WAGTAIL, Motacilla melanope Pallas.

This species is called Sarsarakinod or Gigiot in Ilocos and Pangasinan; Baticulo or Pipit kakaniud, Tagalog; Titidiot, Bangkiyud, or Kiyudkiyud, Eastern Visaya.

It is found throughout the Philippine Islands.

It is usually found either singly or in pairs, or in flocks in the presence of abundant food supply in open fields. When one is walking in the field, he is caught unaware by the sudden flush of this bird. It has a wavering flight as though constantly proposing to alight. It is restless, always moving up and down the posterior part of the body even when it is walking.

There were two stomachs collected, one in Baybay, Leyte and the other in Ormoc of the same province. They contained 6 lo-

cust hoppers, 60 per cent of the food contents; 4 unidentified insects, 40 per cent.

Sometimes this bird is seen in big flocks, numbering over a hundred individuals. A big flock can surely do a great help in the destruction of locust hoppers. The writer had observed a flock of over 70 individuals that controlled a locust-hopper infestation covering one-fourth of a hectare within two weeks. It takes its prey as it runs and hops.

PHILIPPINE ORIOLE, Oriolus chinensis chinensis Linn. Plate 5, fig. 1.

This bird is called Kiao in Ilocos; Kuliawan, Tagalog; Tulihao or Antulihao, Eastern Visaya; Duyao or Kikiyao, Bicol; Tulihao, Western Visaya.

It is found throughout the Philippine Islands.

It is seen in pairs in trees and shrubs. It is a strong flyer, making undulation in its flight as in the case of some passerin birds. Its characteristic note is "kiao or kuliawan or tulihao" from which the natives derive its name as in other birds, for the natives usually name the bird after its characteristic note.

The two stomachs collected, one in Albuera, Leyte and the other in Sta. Rita, Samar, contained 1 locust, 4 per cent of the food contents; 3 unidentified insects, 11 per cent; 22 seeds of wild fruit trees, 85 per cent.

NORTHERN DRONGO, Dicrurus hottentottus striatus Tweeddale. Plate 5, fig. 3.

This species is called Wakwak or Agad-agad in Eastern Visaya; Putol susô, Mindoro.

It is found throughout the Philippine Islands.

It is not common. It is found in pairs under bushes near the forest.

There were two stomachs collected in Albuera, Leyte, and they contained 5 locust hoppers, 33 per cent of the food contents; 2 katydids, 13 per cent; 2 weevils, 13 per cent; 2 hymenoptera, 13 per cent; 1 leaf beetle, 7 per cent; 3 unidentified insects, 20 per cent.

BLACK-BACKED COLETO, Sarcops melanonotus Grant. Plate 4, fig. 3.

This bird is called Coleto or Coling in Ilocos and Tagalog; Saling, Cebu; Iling, Western Visaya; Sungko langit or Coling, Mindoro; Coling, Northern Mindanao.

It is found throughout the Philippine Islands.

The black-backed coleto is found either in pairs or in flocks. It has a characteristic note "coling" which is high pitch and metallic. It is a heavy flyer. When it flies the flapping of the wings is very audible even at a distance.

cost hoppers, 60 per cent of the food contents; 4 unidentified

The two stomachs taken in Sta. Rita, Samar, contained 1 locust flyer, 6 per cent of the food contents; 17 seeds of wild fruit trees, 94 per cent.

PHILIPPINE GLOSSY STARLING Aplonis panayensis panayensis (Scopoli). Plate 6, fig. 7.

This species is called Pius in Ilocos; Coraching, Tagalog; Galanciang, Ganciang, or Mandeleciang, Eastern Visaya.

It is found throughout the Philippine Islands.

It is seen either in pairs or in flocks. It is this species that nests in the bamboo tubes placed in the acacia trees in front of the city hall of Cebu, Cebu, and the municipal hall of Ormoc, Leyte. It is hard to distinguish between the northern drongo and this bird at a distance, but anyone who is acquainted with their habitats can easily tell which is which because the northern drongo lives in a lower strata and away from towns while the other lives in a higher strata and often seen in towns.

There were 3 stomachs taken in Ormoc, Leyte and they contained 1 locust flyer, 33 per cent of the food contents; 2 seeds of wild fruit tree, 67 per cent.

This species was seen catching flyers on the wing. It catches the flyers with its bill and then goes to perch. It kills the victim by bumping it on the perch after which it swallows.

CHINESE STARLING, Aetheopsar cristatellus Linneaus. Plate 5, fig. 5.

This bird is called Martinez in Ilocos and Tagalog.

It is found only in the island of Luzon, Philippine Islands.

It is said that this bird was imported from China by the Spanish Governor, Juan Martinez, to combat the locust plague. It is seen either in pairs or in flocks. A big flock is sometimes seen in places where garbage are dumped for they feed on some of the refuses, and pig pens to have a share of the pig's feed.

There were three stomachs collected in Lemery, Batangas, and they contained 16 locust flyers, 51 per cent of the food contents; 5 grasshoppers, 16 per cent; 2 katydids, 6 per cent; 6 unidentified insects, 19 per cent; 2 seeds of wild fruit trees, 6 per cent.

PHILIPPINE CROW, Corvus coronoides philippinus Bonaparte. Plate 3, fig. 2.

This bird is called Wak in the native dialects.

It is found in all the provinces, except Palawan, in the Philippine Islands.

It is usually seen either in pairs or in flocks. It is a heavy flyer, but it can fly far. Its characteristic note is "wak-wak-wak."

There were five stomachs taken, one in Lemery, Batangas, two in Sta. Rita, Samar, two in Ormoc, Leyte, and they contained 18 locusts, 15 per cent of the food contents; 1 katydid, 0.8 per cent; 7 dried fruit beetles, 6 per cent; 2 unidentified insects, 1.2 per cent; 20 seeds of peanut, 16 per cent; 52 kernels of young corn, 43 per cent; 22 seeds of wild fruit trees, 18 per cent.

It is said that crow are good guides for locust scouters in locating locust infestations, especially hopper infestations. In some cases this is true, but in other cases it is not. The writer shot a crow in a peanut field infested with young flyers and hoppers. It was found that the stomach did not contain any trace of locust, but all peanut seeds. In another case the writer shot a crow in a corn plantation infested with hoppers of the different stages. The corn plants were having young ears. It was found that the stomach did not contain locust, but young kernels of corn and dried fruit beetles. These show that the crow forsakes the locust in the presence of peanuts and young ears of corn.

This species has been observed destroying eggs and preying on chicks and small birds.

SUMMARY AND CONCLUSIONS

From the results of the observation so far, as presented in this paper, the following birds are decidedly good locust eaters:

1. Malayan Brahming Kite, *Haliastvr indus intermedius* Gurney.
2. White-throated Kingfisher, *Halcyon smyrueulis gularis* (Kuhl).
3. Javan Coucal, *Centropus bengalensis javanensis* (Dumont).
4. Guava Bulbul, *Pycnonotus goiavier goiavier* (Scopoli).
5. Tic-wee Buzzard, *Butastur indicus* (Gmelin).
6. Large-nosed Shrike, *Lanius schach nasutus* (Scopoli).
7. Philippine Ashy Crake, *Poliolimnas cinereous collingwoodi* Mathews.
8. Red-winged Coucal, *Centropus viridis* (Scopoli).
9. Striated Marsh Warbler, *Megalurus palustris forbesi* Bangs.
10. White-bellied Swallow Shrike, *Artamus leucorhyncus leucorhyncus* (Linneaus).
11. Common Swallow, *Hirundo rustica gutturalis* Scopoli.
12. Gray Wagtail, *Motacilla melanope* Pallas.
13. Chinese Starling, *Aetheopsar cristatellus* Linneaus.
14. Indian Cattle Egret, *Ardeola ibis coromanda* Linneaus.
15. Pied Chat, *Saxicola caprata caprata* (Linneaus).
16. White-collared Kingfisher, *Halcyon choris collaris* (Scopoli).
17. Koch's Artamides, *Coracina striata kochi* (Kutter).

The following birds are partial locust eaters:

1. Philippine Glossy Starling, *Aplonis panayensis panayensis* (Scopoli).
2. Northern Drongo, *Dicrurus hottentottus striatus* Tweeddale.
3. Broad-billed Roller, *Eurystamus orientalis orientalis* (Linneaus).
4. Golden-headed Cisticola, *Cisticola exilis rustica* Wallace.
5. Samar Tariktik, *Penelopides panini samarensis* (Steere).
6. Green-headed Beebird, *Merops superciliosus philippinus* Linneaus.
7. Black-backed Coleto, *Sarcops melanonotus* Grant.
8. Philippine Oriole, *Oriolus chinensis chinensis* Linneaus.
9. Watercock, *Gallicrex cineria* (Gmelin).
10. Philippine Crow, *Corvus coronoides philippinus* Bonaparte.

The following birds are locust eaters but at times they do injury to certain crops and fruits. However, the damage done is often insignificant as to be ignored. Moreover, most of the fruits eaten are mostly those of wild trees.

1. Philippine Crow, *Corvus coronoides philippinus* Bonaparte.
2. Philippine Glossy Starling, *Aplonis panayensis panayensis* (Scopoli).
3. Black-backed Coleto, *Sarcops melanonotus* Grant.
4. Chinese Starling, *Aetheopsar cristatellus* Linneaus.
5. Philippine Oriole, *Oriolus chinensis chinensis* Linneaus.
6. Guava Bulbul, *Pycnonotus goiavier goiavier* (Scopoli).

The following birds are good locust eaters, but at times attack poultry and small beneficial birds, as has been observed in the field:

1. Tic-wee Buzzard, *Butastur indicus* (Gmelin).
2. Malayan Brahming Kite, *Haliastur indus intermedius* Gurney.
3. Philippine Crow, *Corvus coronoides philippinus* Bonaparte.
4. Large-nosed Shrike, *Lanius schach nasutus* (Scopoli).

The following birds as their names suggest except the Indian cattle egret, take a great deal of locust but feed on small fishes:

1. White-collared Kingfishers, *Halcyon chloris collaris* (Scopoli).
2. White-throated Kingfisher, *Halcyon smyrneulis gullaris* (Kuhl).
3. Indian Cattle Egret, *Ardeola ibis coromanda* (Boddaert).

SUGGESTIONS

No matter how few the number of locusts a bird eats, it is without doubt valuable in the suppression of the pest, especially if the species is abundant. If a locust eating bird is not actually doing damage to crops in the locust infested regions, it should be left alone to continue its beneficial work; if it does damage to crops more than it does to the pest, as the Philippine crow

at times it should be controlled or driven away. Those that are decidedly locust eaters which do not damage crops, poultry, etc., as the Indian cattle egret, striated marsh warbler, gray wagtail, white-bellied swallow shrike, large-nosed shrike, common swallow, etc., should be protected by municipal ordinances in accordance with existing laws, such as those passed by the municipal council of Palo, Leyte, Cotabato, etc., in connection with the Indian cattle egret prohibiting their destruction in any manner. Their multiplication, if possible should be encouraged by providing them with adequate breeding places. Existing laws dealing with bird protection and conservation should be rigidly and adequately enforced.

ACKNOWLEDGMENT

This study was suggested and encouraged by Dr. Gonzalo Merino and Mr. Faustino Q. Otanes, Chief and Assistant Chief of the Plant Pest and Disease Control Division of the Bureau of Plant Industry, respectively, who were responsible for the writer's assignment to the locust control work to give him an opportunity to observe and collect materials for this study and who gladly and immediately approved the acquisition of materials needed for the collection.

Thanks are due to Dr. Canuto G. Manuel, Ornithologist of the Bureau of Science, for his timely criticisms and suggestions.

ILLUSTRATIONS

Plate 1

Fig. 1. Indian Cattle Egret (*Ardeola ibis coromanda* Boddaert).
2. Watercock (*Gallivex cineria* Gmelin).

Plate 2

Fig. 1. Tic-wee Buzzard (*Butastur indicus* Gmelin).
2. Malayan Brahminy Kite (*Haliastur indus intermedius* Gurney).

Plate 3

Fig. 1. Samar Tariktik (*Penelopides panini sarensis* Steere).
2. Philippine Crow (*Corvus coronoides philippinus* Bonaparte).

Plate 4

Fig. 1. Javan Coucal (*Centropus bengalensis javanensis* Dumont).
2. Broad-billed Roller (*Eurystamus orientalis orientalis* Linn.).
3. Black-backed Coleto (*Sarcops melanonotus* Grant).

Plate 5

Fig. 1. Philippine Oriole (*Oriolus chinensis akinensis* Linn.).
2. Kochi Artamides (*Coracina striata kochi* Kutter).
3. Northern Drongo (*Dicrurus hottentottus striatus* Tweeddale).
4. White-throated Kingfisher (*Halcyon smyrueulis gullaris* Kuhl).
5. Chinese Starling (*Actheopsar cristatellus* Linn.),
6. White-collared Kingfisher (*Halcyon chloris collaris* Scopoli).
7. Large-nosed Shrike (*Lanius schach nasutus* Scopoli).

Plate 6

Fig. 1. Guava Bulbul (*Pycnonotus goiavier goiavier*, Scopoli).
2. Common Swallow (*Hirundo rustica gutturalis* Scopoli).
3. Pied Chat (*Saxicola caprata caprata* Linn.).
4. Golden-headed Cisticola (*Cisticola exilis rustica* Wallace).
5. White-bellied Swallow Shrike (*Artamus leucorhyncus leucorhyncus* Linn.).
6. Striated Marsh Warbler (*Megalurus palustris jorbesi* Bangs).
7. Philippine Glossy Starling (*Aplonis panayensis panayensis* Scopoli).
8. Green-headed Beebird (*Merops superciliosus philippinus* Linn.).

Plate 7

Some of the locusts found in the stomach of the birds.

PLATE 1.

PLATE 2.

PLATE 3.

PLATE 4.

PLATE 5.

PLATE 6.

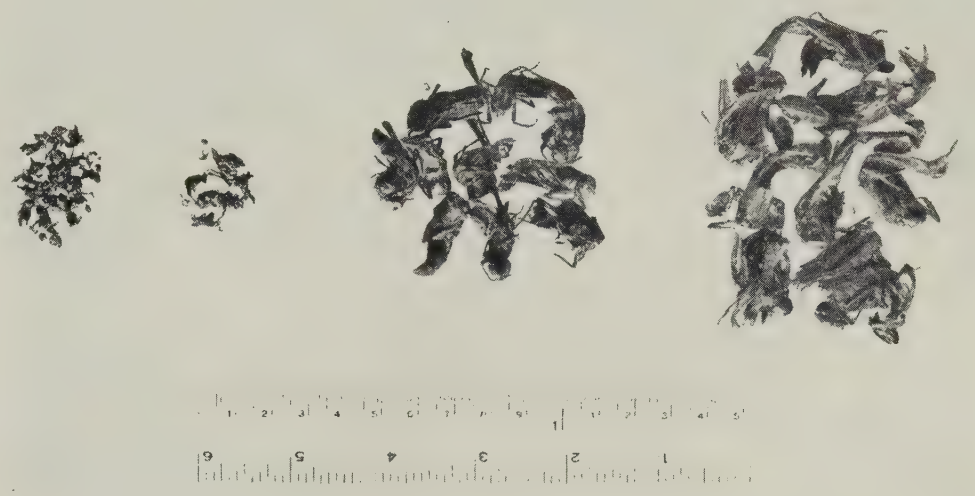

PLATE 7.

INFLUENCE OF THE NUMBER OF LEAVES ON THE DEVELOPMENT AND QUALITY OF CARABAO MANGO FRUITS

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TWO TEXT FIGURES

One of the most salable and well liked fruits in the Philippines is mango, *Mangifera indica* L. The Carabao variety because of its superior quality is much more preferred to any other mango varieties. Mango fruits in a limited quantity are being exported annually especially to Hongkong and China. In 1936, this export amounted to 1,289,480 kilos of fresh fruits valued at ₱125,762 as against 2,610,747 kilos, worth ₱273,871 in 1935. Heretofore, in spite of the popularity of the mango fruits, very little work if any, has been attempted to find some means of improving and standardizing its size and quality so as to suit the taste of the discriminating public and to command a better price in the market.

Although the size and quality of the fruits of a variety or a strain of a certain fruit tree may be influenced by various factors, such as light, heat, moisture, age of the tree, the fertility of the soil, etc., yet the most fundamental requirement of the production of fruits of good quality is the careful selection of the planting material, because the quality of the fruit depends to a great extent on the hereditary characters of the bud and the root stock, regardless of the combined effects of all the aforementioned factors.

It seems also a common belief that poorly developed fruits are largely due to the insufficient number of leaves supporting the fruits, which may either be due to old age, to poor root system, or to the poor fertility of the soil. In the case of apple, pear, and citrus, it was found that the size and quality of the fruits depend on the number of leaves supporting them. The present study aims to find the influence of the number of leaves on growth, size, weight and quality of carabao mango fruits.

REVIEW OF LITERATURE

Kraybill *et al.*(4) and Magnes *et al*(5) studied the influence of the leaf-area on the development of the fruits of apple and pear. The work of Shamel and Pomeroy(6), (7), (8), (9), and (10) dealt mostly with different Citrus fruits, such as Washington Navel orange, Marsh grapefruit, Valencia orange, and Eureka lemon. These authors aimed to determine the number of leaves necessary to bring a single fruit to a commercial size and quality.

According to Kraybill *et al.*(4), 30 leaves were necessary to produce a good apple fruit. Any further increase to this number of leaves did not appreciably improve the size of the fruit. They also state that fruits of apple and pear grown with greater leaf-area were not only larger but higher in sugar content, higher in acidity, and on the whole, had better flavor than the fruits grown with reduced amount of foliage. The same authors also found that apple branches allowed 10 to 20 leaves per fruit neither thickened nor formed flower buds the year following, except Jonathan and Rome Beauty and some in Delicious and Winesap varieties, whereas with 40 to 50 leaves, developed blossoms freely in all the varieties.

Magnes *et al.*(5) state that the greater the leaf-area, the less proportionate, in size, is the fruit. For instance, these authors found that with 10 leaves per fruit of apple there was an increase in volume of the fruits from slightly less than 40 to 180 cubic centimeters, or a gain of 140 cubic centimeters per box of fruits. With 20 leaves per fruit, the gain was only 30 to 250 cubic centimeters, or a gain only of 220 cubic centimeters per box. Thus, it might be seen that although the number of leaves was doubled, the gain per fruit was not proportionately increased. The response of pears to the same treatment was similar to that of the apple.

Shamel *et al.*(6), (7), (8), (9), and (10) did not only observe the relation of growth and the ultimate size of fruits to the number of leaves of the Citrus varieties they worked with but also the influence of light duration on the size of the fruits. For instance, they found the fruits on the northern side larger than those on the southern side. These authors found that in the case of Washington Navel orange, 50 to 60 leaves per fruit was as good as those with all the leaves intact, which may be termed normal number of leaves. With Marsh grapefruit, 60 to 75 leaves per fruit grew as big as those with all the leaves. The

other Citrus they worked with showed that the fruits with 60 leaves developed as those with no defoliation at all.

MATERIALS AND METHODS

For convenience the study was divided into three sets, namely, Experiment I, II, and III. The procedure followed in each experiment is described separately as follows:

Experiment I.—During the 1934–35 fruiting season, five fruiting Carabao mango trees at Novaliches, Rizal [1] were selected for this study. These trees were blown down by the October, 1934 typhoon, but the conditions of the trees were normal. Scattered bearing twigs having fruits of almost the same age and ranging from 5 to 10 mm in thickness were labeled on each tree. Only the soundest fruit was left on each twig, the rest were all carefully removed. Weekly measurements were made of these fruits until they matured or dropped off prematurely. For this purpose, white cardboard ruled to millimeter square was employed. The cardboard was placed behind and as close as practicable to the fruit and the reading was noted. By this method, unnecessary injuries on the fruits which otherwise might have caused the premature falling of the fruits was avoided.

The number of leaves for each of the variables ranged from zero to 25 per fruit, counting the leaves from the tip of the twig. Thus, the twigs with one fruit each were defoliated as follows: 0, 5, 10, 15, 20, and 25 leaves per fruit. Each variable was replicated at least four times on each of the five trees. In other words, there were at least 20 fruits measured for each variable, except where there were no sufficient suitable fruits available as in the case of 25 leaves per fruit. The twigs were not ringed or girdled, but the excess leaves were removed so as to limit the number of leaves supporting a fruit (see fig. 2). In case the number of leaves required for the fruit was insufficient, the leaves of the next lower shoot were used. There were 25 fruits used as control, that is, five fruits on each tree used.

As the size of mango leaves vary considerably, two sets of leaves of the same number may differ in areas. It was therefore necessary that the leaves required for the development of a mango fruit be expressed in terms of total leaf-area per fruit.

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[1] This mango plantation is owned by Dr. Nicanor Jacinto. It was previously leased to the Bureau of Plant Industry for experimental purposes.

This was made feasible by the use of a planimeter. In doing this, exact prints of the leaves were first made by pressing the leaves on paper after smearing dilute aqueous solution of light green on their surfaces. In some cases, the outlines of the leaves were obtained by pressing the leaves flat on the paper and then tracing the edges with the use of a pencil. In other cases, to facilitate the work, the use of photographic negatives was resorted to. The leaves were held flat on the negative by placing them between two pieces of glass and then exposing them to the light. By this method exact prints of the leaves were obtained. The areas of the prints were then measured by the planimeter as already mentioned above.

Experiment II.—This experiment was carried on a single tree in the mango orchard of the Lamao Horticultural Station, Limay, Bataan, during the 1934–35 fruiting season. The method employed here was practically the same as in Experiment I, except that instead of removing only the excess leaves, a girdle was made just below the required number of leaves (see fig. 1). The ring or girdle was as wide as the diameter of the twig. It was considered that the girdle was necessary to confine as much as possible the effect of the leaves under study and to limit the support of the fruit under Experiments I and II. No treatment was given the girdles inasmuch as there was not much loss of sap, the wound having dried after an hour or so from the time the girdle was made.

The variables studied were 5, 10, 15, 20, 25, 30, 35, 40, and 50 leaves per fruit. Ten fruits were originally labeled, treated and measured for each variable. In addition, ten fruits or practically the same size and condition as those above were used as control. The leaves used in the control were indefinite in number, i. e., not a single one was removed as they occurred in the tree. The control aims to find the normal size of the fruit under natural conditions.

In cases where there were more than one fruit in a panicle and both of them were used in the observation, the corresponding number of leaves for the variable under consideration was used, that is, if two fruits were on the same panicle and 15 leaves were desired for each fruit, the ring was made below the thirtieth leaf from the tip of the bearing twig. In case one of the fruits fell off during the course of the experiment, the leaves assigned to the fallen fruit were removed to maintain the required condition.

Measurements of the fruits were started as soon as they attained the size of a thumb or about five weeks after the fertilization of the flowers. The widths, lengths and thickness of the fruits were recorded weekly until they dropped off or harvested.

Experiment III.—This experiment was more or less a repetition of Experiment I and II. It was carried during the 1935–36 fruiting season at the Lamao Horticultural Station, Limay, Bataan. Five trees were selected for this experiment. The trees were approximately of the same age, size, vigor and were grown under similar soil and climatic conditions. The shortest distance between the trees was 12 meters. Fruits for each variable were selected from the different trees, and care was taken so as to have each variable uniformly represented on each tree. The fruits selected were located on all sides of the crown, as north, east, south and west.

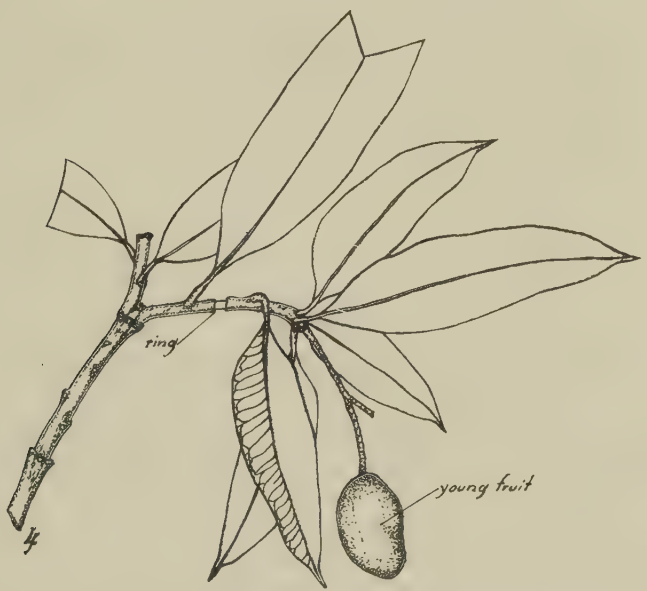

FIG. 1. A sketch of a Carabao mango bearing twig showing the ring or gridle.

In this experiment girdling as well as defoliating the twigs as a means of limiting the number of leaves per fruit of each of the variable was carried. In the defoliating method, the excess leaves down to the nearest twig were removed (see fig. 2). In some cases, it was also necessary to thin the excess number

of fruits to conform with the required number of leaves present on the twig.

In this experiment, greater number of individual fruits were studied. Twenty-five fruits each were used for the girdling and the defoliating methods, or a total of 50 fruits for each of the variables, 0, 5, 10, 15, 20, 25, 30, 35, 40, 50 leaves and the check.

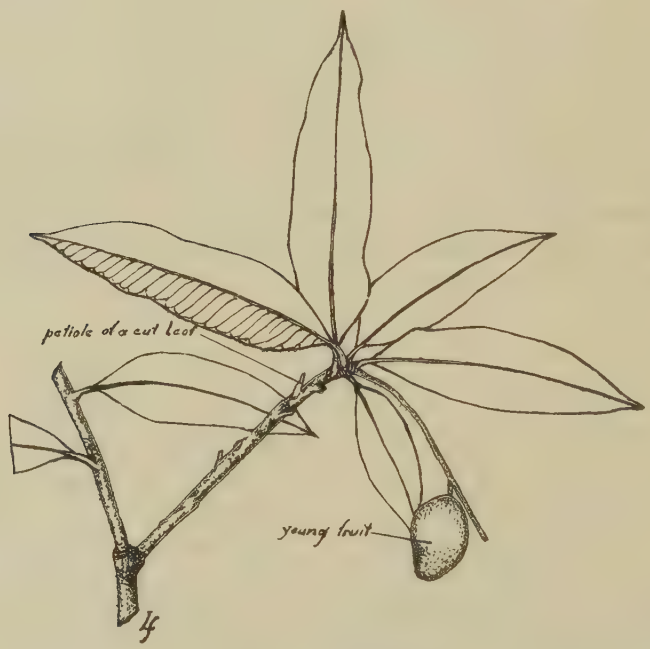

FIG. 2. A sketch of a Carabao mango bearing twig showing the petioles of the cut leaves

Measurements of the fruits were started as soon as they were a few millimeter thick. The length, width and thickness of each fruit under observation were recorded at weekly intervals until they dropped off prematurely or until ready for harvest in the case of those that remained.

Immediately after harvesting, the weights of the individual fruits were taken. As soon as the fruits ripened, they were studied in a more or less general way as regards appearance, color of flesh, sweetness and general quality.

In spite of all the possible care taken in the selection of the fruits for experiment, still a few of the fruits and some of the leaves dropped off during the course of the study. Such dropping somehow interferred in the outcome of the experiment.

TABLE I.—*Showing the data obtained during the 1934–35 fruiting season of Carabao mango at Novaliches, Rizal*

Number of leaves per fruit	Leaf-less	5-leaves	10-leaves	15-leaves	20-leaves	25-leaves	Control
Original number of fruits	20	20	20	20	20	4	25
Number of harvested fruits	15	14	14	16	13	4	15
Approximate age of fruits at maturity in days	42–63	42–63	42–63	42–63	42–63	56–63	35–63
Leaf-area per fruit in sq. cm	----------	261.430	478.670	665.940	1,072.940	1,386.875	Indefinite
Fruit size index in sq. cm	67.109	62.961	65.259	69.582	77.829	75.870	68.753
Fruit growth index in sq. cm	31.465	25.603	29.085	31.286	39.204	59.151	37.792

TABLE II.—*Showing the data during the 1934–35 fruiting season of Carabao mango at the Lamao Horticultural Station, Limay, Bataan*

Number of leaves per fruit	5-leaves	10-leaves	15-leaves	20-leaves	25-leaves	30-leaves	35-leaves	40-leaves	50-leaves	Control (Indefinite Number of leaves)
Original number of fruits	10	10	10	10	10	10	10	10	10	10
Number of harvested fruits	3	6	7	3	8	7	6	4	4	7
Approximate age of fruits at maturity in days	63	35	35–63	35–63	42–63	35–63	63	42–63	35–63	35–63
Fruit size index in cu. cm	133.23	424.79	180.81	396.83	277.53	262.29	316.96	580.18	433.21	593.31
Fruit growth index in cu. cm	6.22	45.04	8.42	73.75	25.90	34.92	59.68	111.66	86.11	126.41

TABLE III.—*Showing the data during the 1935–36 fruiting season of Carabao mango at the Lamao Horticultural Station, Limay, Bataan*

Number of leaves per fruit	Number of leaves up to nearest twig	5-leaves		10-leaves		15-leaves		20-leaves		25-leaves	
		Thinned	Ringed	Thinned	Ringed	Thinned	Ringed	Thinned	Ringed	Thinned	Ringed
Original number of fruits	25	25	25	25	25	25	25	25	25	25	25
Number of harvested fruits	21	13	2	9	6	5	4	10	10	11	5
Approximate age of maturity in days	56–63	56–63	49–63	56–63	56–63	56–63	63	56–63	56–63	63	63
Leaf-area per fruit in sq. cm	----------	308.65	276.20	611.50	478.80	755.25	840.90	1,060.20	1,053.60	1,228.50	1,165.00
Fruits size index in cu. cm	417.79	555.88	193.65	470.32	108.73	532.28	153.87	416.39	180.41	449.92	209.01
Fruit growth index in cu. cm	154.26	381.85	102.54	336.07	30.15	323.65	67.77	219.79	76.79	273.25	93.60
Average weight of harvested fruits in grams	293.6	319.0	117.5	272.7	60.00	310.00	91.3	249.2	111.3	259.6	130.00

Number of leaves per fruit	30-leaves		35-leaves		40-leaves		50-leaves		Indefinite number of leaves (control)
	Thinned	Ringed	Thinned	Ringed	Thinned	Ringed	Thinned	Ringed	
Original number of fruits	25	25	25	25	25	25	25	25	50
Number of harvested fruits	6	9	11	14	11	9	12	10	27
Approximate age of maturity in days	56–63	56–63	56–63	63	56–63	63	56–63	56–63	63
Leaf-area per fruit in sq. cm	1,534.20	1,516.20	1,935.85	1,959.30	1,866.40	1,835.60	2,218.00	2,386.50	----------
Fruits size index in cu. cm	346.32	287.22	477.29	311.88	445.69	304.14	433.89	341.89	487.20
Fruit growth index in cu. cm	168.12	120.20	246.71	139.82	235.23	124.59	188.25	141.22	190.31
Average weight of harvested fruits in grams	210.0	175.6	280.0	183.9	256.5	177.20	258.8	202.9	287.4

TABLE IV.—*Showing the average weight of fruits in grams of the Ringing Experiment from the different direction in the Crown*

Number of leaves	East	North-east	North	North-west	West	South-west	South	South-east
5 leaves	160.0			75 0				
10 leaves	120.0		30.0					
15 leaves	90.0	115.0	50.0	110.0				
20 leaves		102.5	137.5	80.0			132.5	65.0
25 leaves	65.0	95.0				190.0	110.0	
30 leaves	155.0	60.0	150.0			186.7	240.0	
35 leaves			188.3	135.0	188.3	130.0	247.5	120.0
40 leaves		210.0		215.0	170.0		158.0	
50 leaves		266.7	130.0		85.0			202.5
Total	590.0	849.2	685.8	615.0	443.3	506.7	888.0	279.5
Average	118.0	141.5	114.3	123.0	(147.7)	(168.9)	(177.6)	93.2

The data presented are those taken from fruits which were harvested and those that fell off just a week before harvesting.

RESULTS

The results of the experiment are given in summarized forms in Tables I to IV. They show the average growth, size and weight of Carabao mango fruits supported by varrying number of leaves. In table I, the size of the fruits is expressed in square centimeters while in Tables II and III, in cubic centimeters. The areas of the leaves are given in square centimeters.

Table I consists of the data obtained during the 1934–35 fruiting season at Novaliches, Rizal, while Table II indicates those obtained from the Lamao Horticultural Station at Limay, Bataan, during the 1934–35 fruiting seasons. Table III gives the 1935–36 results of defoliating and ringing the twigs as a means of limiting the number of leaves sustaining a fruit. Table IV presents the average weights in grams of fruits from the ringed lots situated at different directions in the crown of the trees.

DISCUSSION OF RESULTS

As shown in Table I, the size of the fruits increased as the number and areas of leaves increased up to 20 leaves per fruit, (Chart I, Table I fruit size index). The fruits with 5 leaves, having an area of 261.430 sq. cm. showed an average size of 62.961 sq. cm.; those with 10 leaves or with 478.67 sq. cm. leaf-area, averaged 65.259 sq. cm. in size; while those with 15 leaves with an area of 665.94 sq. cm. and 20 leaves with 1,072.94 sq. cm. leaf-area averaged in size 69.582 and 77.829 sq. cm., respectively. The fruits with 25 leaves or with a leaf-area of 1,386.875 sq. cm. showed an average size of 75.87 sq. cm., whereas those of the controls, were intermediate in size between the fruits having 10 and 15 leaves, respectively.

In Table I, it is apparent that the average total growth index increased with the number of leaves up to a certain limit, thus fruits with 5 leaves showed a total growth index 25.603 sq. cm. and those with 10 leaves, 29.085 sq. cm., while those with 15, 20, and 25 leaves gave 31.286, 39.204, and 59.151 sq. cm., respectively. The controls gave 37.792 sq. cm. average total growth index.

Further examination of Table I shows that the fruits without leaves reached an average size of 67.109 sq. cm. and a total growth index of 31.465 sq. cm. In other words, the fruits born on a leaf-less twig were bigger than those with 5 and 10 leaves, and they gave a greater growth index than the fruits having 5, 10, and 15 leaves. The results, therefore, apparently suggest that the fruits were able to depend upon the leaves remaining on the twigs or even upon those on the neighboring twigs(5).

Table II (see Chart I of Table II, fruit size index), shows that the control fruits, that is, those supported by as many leaves as naturally present on the trees attained the biggest size which was 593.31 cu. cm., followed by those with 40 leaves with the average size of 580.18 cu. cm. The third largest fruits were those with 50 leaves, with an average size of 433.21 cu. cm. The smallest fruits were obtained from those with 5 leaves to a fruit, the average size being only 133.24 cu. cm.

The lot with 10 leaves each fruit attained an average size of 424.79 cu. cm. Those with 15, 20, 25, 30, and 35 leaves per fruit reached varying sizes but smaller than those with only 10 leaves each. These irregularities seem inevitable when conditions surrounding the experiment are considered. For instance, the position, location, exposure and the age of the leaves should be taken into account. These factors no doubt influenced the photosynthetic activities of the leaves(1), thus helping determine the ultimate size of the fruits. Had it been possible to have every attending factor under perfect control, there might have been a gradual decrease of the size of the fruits from indefinite number of leaves down to five leaves per fruit. At any rate the general trend of the results of the experiment as graphed in Chart I, (Table II fruit size index and fruit growth index) suggests that in mango, the more the leaves that support a fruit, the bigger size the fruit may attain. The irregularities in the curve, particularly at 10 leaves and 20 leaves were probably due to the premature falling of the fruits and comparatively more advance size of the fruits at the start, as in the case of 10 leaves per fruit. Had all the fruits reached maturity, perhaps the curve would have been more regular. For example, in the case of 20 leaves (Table II), it may be said that the fruit that reached maturity was robust and was above the average fruits in vigor. As may be deduced from Table II, there were quite a number of premature falling of fruits, taking into account that the orig-

inal number as 10 for each lot. Thus, with 5 leaves, 7 fell; 10 leaves, 4; 15 leaves, 3; 20 leaves, 9; 25 leaves, 6; 30 leaves, 3; 35 leaves, 4; 40 leaves, 6; 50 leaves, 6; and control 3 fruits fell.

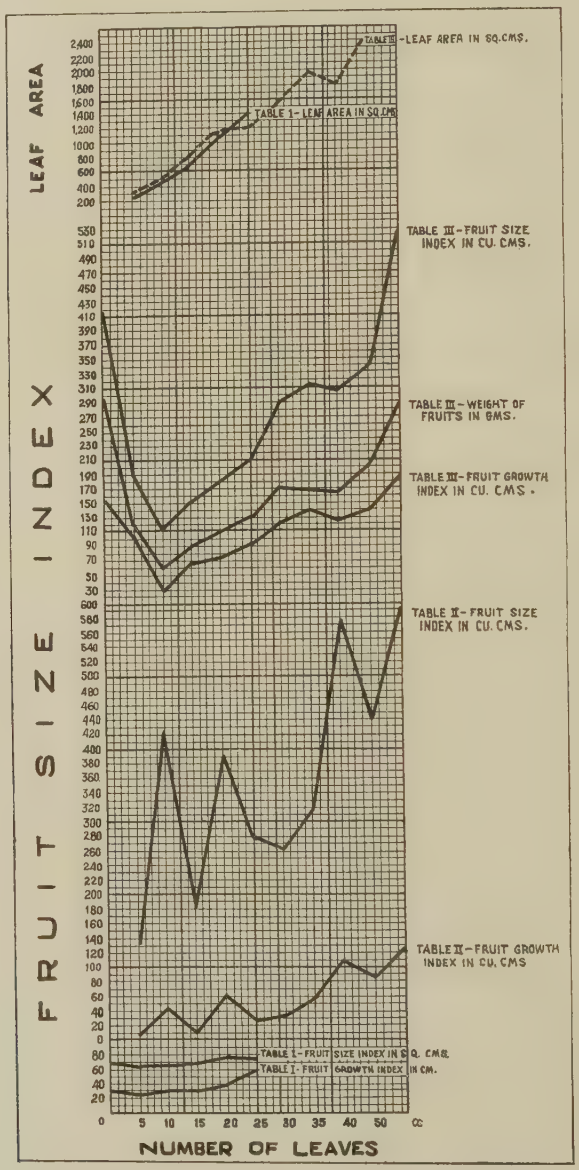
LEAF AREA
FRUIT SIZE INDEX
TABLE II - LEAF AREA IN SQ. CMS.
TABLE I - LEAF AREA IN SQ. CMS.
TABLE III - FRUIT SIZE INDEX IN CU. CMS.
TABLE III - WEIGHT OF FRUITS IN GMS.
TABLE III - FRUIT GROWTH INDEX IN CU. CMS.
TABLE II - FRUIT SIZE INDEX IN CU. CMS.
TABLE II - FRUIT GROWTH INDEX IN CU. CMS
TABLE I - FRUIT SIZE INDEX IN SQ. CMS.
TABLE I - FRUIT GROWTH INDEX IN CM.
NUMBER OF LEAVES

CHART 1. Showing the fruit size index, the growth and the weight of the fruits together with the corresponding leaf areas of the girdled twigs.

From Table II, (see also Chart I) it may be noted that the average total growths followed almost the same trend as the total size of the fruits. The fruits with all the leaves intact, gave a growth index of 126.41 cu. cm., followed by 40 leaves with 111.66 cu. cm., then 50 leaves with 86.11 cu. cm. came next, and the fruits with 20 leaves came in as fourth, giving a growth index of 73.75 cu. cm.

The results indicate that 40 leaves to a fruit were enough to produce fruits almost equal in size with those produced with all the leaves.

Considering the two methods of limiting the number of leaves per fruit (Table III), it is evident that ringing the twigs produced in all cases much smaller fruits than those of the thinned lots. Apparently, ringing rendered the isolated portion independent from the other parts of the plant, to a certain extent, especially so as regards manufactured food supply(2). This possibility becomes more apparent when the fact that fruits on totally defoliated but not girdled twigs, developed fully and in some cases were even bigger than others with leaves, is considered. In this case there was an apparent dependence of the fruits for support from the lower leaves.

With thinning or defoliating as a method, the data show that the lot with five leaves per fruit were the largest, the heaviest and made more growth than the fruits with a greater number of leaves each. As a whole, the results of thinning the leaves gave inconsistent gradation of sizes of fruits from the different variables used. With the ringing or girdling method, the size, rate of growth and weight of fruits with 15, 20, 25, 30, and 35 leaves followed a regular and a more or less smooth upward trend as in the areas of leaves (see Chart I, graphs of Table III). These graphs show that the size, growth and weight of the fruits of the girdled twigs, having 5 leaves and 35 leaves to the fruit, were somewhat abnormally high to distort the curve. This was due perhaps to premature falling of fruits as already explained elsewhere in this paper. For instance in the case of 5 leaves per fruit lot, only two out of 25 fruits studied survived the treatment, so it may be said that the two fruits had superior strength and vigor. Regarding the distortion of the curve by the 35 leaves per fruit lot, it should not be taken as irregularity and contradictory to the general trend of the results of the study, for in fact it served as another sustaining proof that taking other conditions equal, the more leaf-area supporting a mango

fruit, the more nearly the fruit reached its greatest development. In this particular case the leaf-area of the 35 leaves was greater than that of the 40 leaves (see Table III).

The fruits with indefinite number of leaves (control) were largest and heaviest and they made the most growth among the (ringed) lots. This, however, did not hold true in the case of thinning method.

With defoliation, the largest fruits were found with the 5 leaves (area—308.65 sq. cm.) lot. The fruits with leaf-areas 2,218.00 sq. cm. (50 leaves), 1,935.85 sq. cm. (35 leaves) and 1,866.40 sq. cm. (40 leaves) were the next biggest in the order of their enumeration and they were 433.89, 477.29 and 445.69 cu. cm., respectively. The fruits with an indefinite number of leaves each, had an average size of 487.20 cu cm.

As regards the general appearance and quality of fruits, those supported by 5 leaves (ringing method) were generally abnormal in form, and the flesh was not so sweet. The seeds appeared sound. The fruits supported by 10 leaves were very much better in taste. The flesh was rich yellow, sweet and of excellent flavor. They matured more uniformly and earlier. The fruits supported by 15 leaves and upwards, that is, 20 leaves to indefinite number (control) were more or less similar to those with 10 leaves. However, their dates of maturity were irregular and generally later. It seems likely that a Carabao mango fruit requires at least 10 leaves for its fair development as to quality.

It was mentioned elsewhere in the paper that the position of the leaves and their degree of exposure to sunlight each day during fruit development may play an important role in the ultimate size of fruits. The results of Experiment III (ringing method) apparently suggest some effect of light duration on the weight of the fruits (Table IV).

The data, however, are averages of several variable, i. e., 5 leaves, 10 leaves, 15 leaves, etc. as this consideration was only taken as coincidental with the study. Moreover, it was rather impossible to locate fruits on the crown of the trees that are uniformly distributed as regards directions. For this reason the available fruits were divided into lots according to their location on the tree and variously treated according to the principal objectives of the study. The average weights of the fruits were considered. Thus, fruits located at the east side of the crown

had, under this condition, an average weight of 118.0 grams, those on the northeast, 141.5 grams, those on the north 114.3 grams, those on the northwest, 123.0 grams, those on the west, 147.7 grams, those on the southwest, 168.9 grams, those on the south 177.6 grams and lastly those on the southeast weighed 93.2 grams.

It may be seen from the above, that fruits located south, southwest and west were the heaviest among the entire lots. This may be due to the influence of light duration as the sun traveled along this path during that time of the year. This was similar to the findings of Shamel and Pomeroy on their work on Citrus, that the length of daily exposure of leaves to sunlight influenced the development of the fruits. Our results are too meager, but are suggestive of this tendency of fruit development. Nevertheless, it should not be mistaken as conclusive but certainly it serves a good invitation to a pomological problem for other students to work out more systematically.

SUMMARY

1. The paper presents the results of studies on the influence of the number or area of leaves on the growth, size and quality of mango fruits.

2. Two methods, namely, defoliating the leaves and girdling the twigs, to limit the number of leaves to support a mango fruit is presented.

3. The defoliating method for establishing the required number of leaves per fruit gave variable and inconsistent results, while ringing furnished a more uniform and consistent data. The difference in the two methods was due perhaps to interdependence of the different twigs as regards food supply which was possible in the case of the thinning method, but which was rather remote in the girdling method.

4. Based on the results obtained from the girdling method, the growth, size, weight and quality of Carabao mango fruits were influenced by leaf-area supporting it.

5. Generally the fruits on the girdled twigs were smaller than those on the defoliated twigs, especially if the girdling was made nearer the fruit, or with less number of leaves above the girdle.

6. Fruits supported by a greater number of leaves showed a tendency towards irregular and later maturity.

7. The weights of fruits seemed to depend partly on light duration.

8. The data presented in the paper show that 10 leaves were sufficient to support a fruit to a satisfactory quality. Beyond 50 leaves per fruit, the limit used in the experiment, was necessary to develop a good sized Carabao mango fruit, although, 30 to 50 leaves per fruit were considered satisfactory. In general the results indicated that the more leaves supporting a mango fruit, the greater are the chances for the fruit to attain a bigger size. It seems probable that cultural practices in mango orchards could be so modified as to promote or maintain a considerable number of leaves on the tree to insure the perfect development of the fruits.

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ILLUSTRATIONS

TEXT FIGURES

FIG. 1. A sketch of a Carabao mango bearing twig showing the ring or girdle.

2. A sketch of a Carabao mango bearing twig showing the petioles of the cut leaves.

PROGRESS REPORT OF CABBAGE EXPERIMENTS AT BAGUIO, MOUNTAIN PROVINCE[1]

By M. E. Gutierrez

Of the Baguio Plant Industry Experiment Station

INTRODUCTION

Cabbage, *Brassica oleracea,* is the most important vegetable grown at the Baguio Plant Industry Experiment Station. In fact, it ranks first as a truck crop in all Baguio and the Trinidad Valley. The cabbage industry has had a remarkable growth, encouraged and hastened by the influx of keen and skillful Japanese and Chinese gardeners, and it would seem that lack of more suitable land is the only limit to its further extension. Cabbage hectarage surpasses that of any or that of all other truck crop grown. So that now, the Trinidad-and Baguio-grown cabbage not only supplies the ever growing large Baguio market, but also the large surplus finds its way to many parts of the country, principally in Luzon and some parts of the Visayan Islands.

Although our cabbage crop, does not show extra large heads as produced by commercial gardeners in the two places, it is the favorite among fastidious people of Baguio. Among the hosts of cabbage gardens, the station cabbage is recipient of this unique distinction: Americans and Europeans are not afraid to eat it raw, due to its pronounced quality and cleanliness, the latter factor being due to the exclusive use of complete commercial fertilizers in its production.

This station conducts cabbage experiments, principally on the following lines of investigation: regular and rainy season variety tests of American and English seeds, experiments with fertilizers, using commercial fertilizers, and cultural methods. The following pages report in a preliminary way the progress being accomplished with five different experiments.

VARIETY TESTS

Variety tests of cabbage have been continuously conducted at this station, in order to find out the best varieties to plant either for the rainy or regular seasons. So far, we were unable to carry through for several seasons with the same va-

[1] Thanks are due to Mr. Feliciano Domine, Plant Propagator, for his valuable help during the progress of these experiments.

rieties, due either to lack of seeds of the specific varieties tested or insufficient sound seedlings at planting time. In the latter case, our seedlings are not all grown in glasshouses, as they should be in this cold region, for lack of adequate glasshouses for the purpose, and often we cannot get enough good seedlings from our open seedbeds to run the necessary replicated plots. During the rainy season of 1935 and the regular seasons of 1935–36 and 1936–37, three series of variety tests were conducted and which are reported successively.

I. RAINY SEASON VARIETY TESTS OF CABBAGE, 1935

It is the universal belief among gardeners of Baguio and the Trinidad Valley that the only variety of cabbage which can be successfully grown during the rainy season is the Shanghai cabbage. This is a large, late variety, but with soft head and of poor quality. As these gardeners grow cabbage the year round, during the rainy season here, June to October, only this variety is grown.

Objects.—The objects of this experiment were to verify the reason for the preference of these gardeners for the Shanghai variety for rainy season planting, to find other varieties of better quality for this season, and whether it is profitable to grow cabbage during this off-season for vegetables.

Time and place.—This study was conducted during the rainy season of 1935. This, and all the other experiments reported herein were conducted at the Baguio Plant Industry Experiment Station, Baguio, Mountain Province.

It should be remarked that this work was carried out during the worst rainy season in Baguio with unabated rains, often torrential, floods, and storms, such as rarely happens in the locality. The only bad weather that could approach it was that of 1911. The rainfall record during the progress of this study was as follows:

	Millimeter
June	243.4
July	330.2
August	2,346.9
September	597.4
October	223.0
November	860.0
Total	4,600.9 mm.

Materials and methods.—Seeds of ten (10) varieties to be enumerated presently, which served as the different variables

of this experiment were sown on June 13, 1935 in our small glasshouse and in open beds.

A—Succession
B—Stein's Flat Dutch
C—Wisconsin Hollander
D—Surehead
E—Charleston or Large Wakefield
F—Early Winnigstadt
G—Enkhuizen Glory
H—All Head Early
I—Premium Flat Dutch
J—Shanghai (Check)

With the exception of Shanghai and early Winnigstadt, which germinated two days later, the seeds of the other eight varieties germinated on June 18.

On July 12, 22, and 25, the seedlings were sprayed first with 1 per cent lead arsenate solution and then again with Imazu-lead arsenate-soap solution (75 g.-80 g.-80 g in 20 l. of water), which was both a contact and stomach insecticide.

The field which was chosen for this experiment was free from floods and well drained. After a thorough preparation, it was converted into 40 equal-sized beds or plots of 1.10 m. by 10 m. with a path of 30 cm. each and including this corresponding canal or path, each covered an area of 14 sq. m. There were two columns of beds which were arranged as follows:

Before setting the plants in the beds, holes were made, spaced 50 cm. apart each way, in triangles, allowing 38 plants per bed. Into each hole one shovelful of compost and 35 grams of Nitrophoska IG No. 3 (16.5 N-16, 5P205-21.5K20) were applied and were mixed thoroughly with the loose earth. On August 13, the first two replications were planted in their corresponding beds with seedlings taken from the small glasshouse. The next day, the other two replications were planted with seedlings from the open and pricking beds. Due to the very bad weather suffered by these open-grown seedlings, especially during the period of July 29 to August 5, there were not sufficient sound seedlings to complete the planting of four replications. This report, therefore, is limited to three replications with 114 plants per variety.

Spraying of the plants uniformly for all the beds were made at regular weekly intervals with the second solution mentioned.

In August 24 and September 23, the beds were cultivated with hand cultivators after top dressing with ammonium sulphate at the rate of 100 grams per bed each time.

Observations.—Close observations were made periodically with the different varieties with respect to their reaction to the prevailing weather conditions and to the diseases and pests which attacked them. The following varieties suffered from black-leg disease, *Phoma lingam:* Succession, Stein's Flat Dutch, Surehead, Early Winnigstadt, and All Head Early. There were other deaths of plants, apparently due to soft rot or other undetermined diseases. The number of plants of each variety attacked and subsequently killed was as follows:

Succession	2 plants
Stein's Flat Dutch	3 plants
Wisconsin Hollander	2 plants
Surehead	6 plants
Charleston Wakefield	2 plants
Early Winnigstadt	9 plants
Enkhuizen Glory	4 plants
All Head Early	16 plants
Premium Flat Dutch	1 plant
Shanghai	none

It is seen that the Shanghai variety in this experiment was singularly free from diseases. It may be inferred from the above results that it is the most resistant to diseases among the varieties studied. In spite of the strong rains, storms, and weekly sprayings, all the cabbage varieties suffered from the ravages of pests.

In general, it was noted that the plants were somewhat slow in heading and coming to maturity. The dates for each variety were noted for the maturity of the first and the last head, as follows:

A—Succession: October 19 to November 16.
B—Stein's Flat Dutch: October 22 to November 25.
C—Wisconsin Hollander: November 3 to December 6.
D—Surehead: October 23 to November 26.
E—Charleston Wakefield: October 19 to December 6.
F—Early Winnigstadt: October 22 to November 18.
G—Enkhuizen Glory: October 22 to December 6.
H—All Head Early: October 22 to November 25.
I—Premium Flat Dutch: November 3 to December 6.
J—Shanghai: November 14 to December 6.

Results.—Harvest was made by priming at fairly regular intervals. The results are consolidated in the following table:

TABLE 1: 1935.—*Rainy season results of cabbage experiment, showing the number of marketable heads, yield in kilos produced, and average yield, per bed, per cent headed, calculated yields per hectare in kilos and value thereof, and gain or loss per hectare.*

	A—Succession			B—Stein's Flat Dutch			C—Wisconsin Hollander		
	Plot	Headed	Yield	Plot	Headed	Yield	Plot	Headed	Yield
	1A	31	16.70	2B	24	18.84	3C	14	3.54
	11A	13	2.86	12B	22	7.96	13C	4	0.50
	29A	8	2.22	30B	14	4.36	31C	4	1.04
		52	21.78		60	31.16		22	5.08
Average per bed		7.27+3.20			10.387+2.83			1.693+1.40	
Per cent headed		45.6			52.6			19.3	
Calculated yield per hectare		5,283.6			7,416.3			1,208.8	
Value		₱1,056.72			₱1,483.26			₱241.76	
Experiment of production		₱1,035.96			₱1,035.96			₱1,035.96	
Gain or loss		₱20.76			₱447.30			—₱794.20	

	D—Surehead			E—Charleston Large Wakefield			F—Early Winnigstadt		
	4D	37	16.90	5E	30	11.30	6F	24	6.90
	22D	29	8.70	15E	22	9.70	16F	9	2.38
	32D	23	7.52	23E	9	1.96	24F	15	3.92
		89	33.12		61	22.96		48	13.20
Average per bed		11.04+1.75			7.85+1.82			4.40+0.87	
Per cent headed		78.0			53.5			42.1	
Calculated yield per hectare		7,882.5			5,504.9			2,896.4	
Value		₱1,576.50			₱1,100.98			₱579.28	
Experiment of production		₱1,035.96			₱1,035.96			₱1,035.96	
Gain or loss		₱540.54			₱65.02			—₱456.68	

TABLE 1: 1935.—*Rainy season results of cabbage experiment, showing the number of marketable heads, yield in kilos produced, and average yield, per bed, per cent headed, calculated yields per hectare in kilos and value thereof, and gain or loss per hectare*—Continued.

	G—Enkhuizen Glory			H—All Head Early			I—Premium Flat Dutch			J—Shanghai (Check)		
	7G	28	9.08	8H	32	14.88	9I	17	4.54	10J	26	9.66
	17G	10	2.64	23H	23	8.48	19I	7	1.94	20J	22	5.06
	25G	20	8.02	36H	14	5.22	27I	12	2.60	28J	23	7.70
		58	19.74		69	28.58		36	9.08		71	22.42
Average per bed		6.58+1.28			9.53+1.82			3.03+0.51			7.47+0.81	
Per cent headed		50.9			60.3			31.6			62.3	
Calculated yield per hectare		4,698.1			6,804.4			2,163.4			5,333.6	
Value		₱939.62			₱1,360.88			₱432.68			₱1,066.72	
Experiment of production		₱1,035.96			₱1,035.96			₱1,035.96			₱1,035.96	
Gain or loss		—₱96.34			₱324.92			—₱603.28			₱30.76	

[1] At ₱0.20 per kilo wholesale.

Interpretation of results.—Were the weather conditions normal during the progress of this study, it is probable that the varieties would have given a better account of themselves.

The fact should be stressed that our expenses on the hectare basis were somewhat high, because based on experimental basis and secured in an abnormal weather. The Nitrophoska basic fertilizer used was expensive at ₱190 per ton including transportation and is not known as the best fertilizer for cabbage with our soil conditions.

Moreover, for the lack of an adequate glasshouse, the seedlings used were not all equally sound. Our observations for several seasons in Baguio were convincingly in favor of glasshouse-grown seedlings.

It is clear from the above table that in spite of untoward weather conditions with a rainfall of 4,600 mm. during the period covered in this study and the above-mentioned limiting factors six varieties turned out successful, and consequently profitable; namely, Surehead, Stein's Flat Dutch, All Head Early, Charleston Wakefield, Shanghai, and Succession. The first three named varieties showed outstanding results. Shanghai, however, was in the fifth place among the six, but showed slightly superior results to Succession.

As the Shanghai served as check, the relative yields in percentage of the other varieties as compared to it were as follows:

Surehead	148
Stein's Flat Dutch	139
All Head Early	127
Charleston Wakefield	103
Shanghai (Check)	100
Succession	99
Enkhuizen Glory	88
Early Winnigstadt	54
Premium Flat Dutch	41
Wisconsin Hollander	23

The yields registered by the successful varieties in this experiment were one-half to one-third lower than their normal production during the regular season. The all important question arises whether with these depressed yields, it is worthwhile growing cabbage during the rainy season. The answer is in the affirmative with highly adapted varieties for this season, shown in the above table, because the cabbage price during the rainy

season soars two to three times above the price levels during summer. During the summer abundance of cabbage, the price is eight to ten centavos per kilo; on the other hand, during the rainy season the price is from twenty to thirty centavos per kilo, brought about by the small supply and the greater efforts necessary for production.

While the Shanghai did not show the best results in this work, slightly better than Succession, the remarkable fact that during the rainy season it was singularly free from diseases, and consequently the most resistant, may explain the preference of the gardeners for it. It is a fact that during the rainy season the incidence of diseases is more serious than in the regular season and the fear that any of these diseases may acquire virulence, nullifying the crop, hence their reliance to this resistant variety for off-season growing.

SUMMARY

1. A rainy season variety experiment consisting of ten varieties with Shanghai as check, was conducted at Baguio during the rainy season of 1935.

2. The Shanghai is not the only cabbage variety, which can be grown successfully during the rainy season in Baguio. The varieties Surehead, Stein's Flat Dutch, All Head Early, and Charleston Wakefield showed better result, notably the first three.

3. Shanghai was singularly free from diseases in this experiment, which fact shows it to be the most resistant among the varieties studied, hence the preference of the gardeners in planting it exclusively during the rainy season.

4. The following varieties were found not adapted for rainy season plantings: Enkhuizen Glory, Early Winnigstadt, Premium Flat Dutch, and Wisconsin Hollander.

5. It is profitable, but with incident risks, to grow cabbage varieties during the rainy season, as shown by six of the ten varieties studied.

II. VARIETY TESTS OF CABBAGE, 1935–36 REGULAR SEASON

SERIES 1

During the 1935–36 regular cabbage season a set of six, mostly new varieties, was tried for test.

Materials and methods.—Seeds of the varieties mentioned hereunder and serving as variables for these tests were sown separately in open beds on November 12, 1935.

A—Special Succession
B—Danish Ballhead
C—Early Winnigstadt
D—Penn State Ballhead
E—Burpee's Succession
F—Burpee's Surehead

One of the best of the station level fields, was chosen for these tests. After the ground was put in excellent tilth, it was converted into 18 even-sized beds or plots, 1.2 m. by 10 m. with a path of 40 cm. One corresponding path was included in the area of each bed, making 16 sq. m. As there were 9 beds in each column, the varieties were arranged in such a way in order that each variety included different portions of the field for obvious reasons. The beds were arranged as follows:

In January 7–8, 1936, the seedlings of the six varieties were transplanted in their corresponding beds, spacing the plants 50 cm. each way, in triangles, allowing 38 plants per bed. For the three replications, 114 plants were required of each variety. Before setting the plants, each hill received one shovelful of compost and 25 grams of station fertilizer mixture No. 1 with the proximate composition of 10 N—15 P205—8K20. Two dressings of ammonium sulphate of 5 grams each per plant each time, were made on January 26 and on March 17, 1936.

The plants were sprayed uniformly with our standard Imazu-lead arsenate-soap solution at regular weekly intervals.

Likewise, cultivation, watering, and weeding were done uniformly for all the beds.

Results.—Harvests were carried out by priming, beginning March 21 and terminating April 4, 1936. The results of the harvests are consolidated and presented in table 2.

TABLE 2.—*First regular season variety test results with cabbage, showing number of plants heading and marketable, total yield for the three replications, average yield per plot in kilos and per head in grams, percentage headed, and calculated yields per hectare.*

	A—Special succession			B—Danish Ballhead			C— Early Winnigstadt		
	Plot	Headed	Yield	Plot	Headed	Yield	Plot	Headed	Yield
	1A	38	23.26	2B	27	13.10	3C	29	12.82
	7A	27	16.84	8B	13	4.46	9C	15	4.46
	13A	32	26.84	14B	23	12.50	15C	17	9.60
		97	66.94		63	30.06		61	26.88
Average per bed	22.313+1.89			10.02+1.82			8.96+1.55		
Average weight per head in grams[1]	690			477			440		
Per cent heading	85.0			55.3			53.5		
Calculated yield per hectare in kilos	13,945.6			6,262.5			5,600.0		

	D—Penn State Ballhead			E—Succession			F—Surehead		
	4D	24	13.82	5E	30	18.24	6F	36	16.68
	10D	17	6.90	11E	34	19.82	12F	30	16.68
	16D	29	9.46	17E	34	23.58	18F	36	27.66
		70	30.18		98	61.64		102	61.02
Average per bed in kilos	10.06+1.21			20.537+0.91			20.34+2.42		
Average weight per head in grams[1]	503			537			617		
Per cent heading	61.4			85.9			89.6		
Calculated yield per hectare in kilos	6,287.5			12,835.6			12,712		

[1] Calculated per replication, instead of total results of each variable.

Summary.—1. During the 1935–36 regular season, a variety tests of six cabbage varieties were conducted at Baguio.

2. In the order of yield, the six varieties stood as follows: Special Succession, Burpee's Succession, Burpee's Surehead, Penn State Ballhead, Danish Ballhead, and Early Winnigstadt.

3. It is remarkable that our first season results with the three outstanding varieties, Special Succession, Burpee's Succession and Burpee's surehead, follow closely the result obtained at lower altitudes at the Los Baños Economic Garden, Los Baños, Laguna and at the Central Experiment Station, Manila.[1]

4. In percentage of heading, the order was as follows: Surehead, Succession, Special Succession, Penn State Ballhead, Danish Ballhead, and Early Winnigstadt.

5. In the average weight per head, the six varieties stood in the order named: Special Succession, Surehead, Succession, Penn State Ballhead, Danish Ballhead, and Early Winnigstadt.

III. VARIETY TESTS OF CABBAGE, 1936–37 REGULAR SEASON

SERIES 2

As the seeds of the varieties of the first series just described were not available, these tests could not be repeated in the following season. Instead, the station received another set of eight varieties and the second series of variety tests was started.

Materials and methods.—On November 2, 1936, seeds of the following varieties, serving as variables for these tests were separately sown in our small glasshouse.

A—Succession.
B—Premium Flat Dutch.
C—Large Charleston Wakefield.
D—Improved All Head Select.
E—All Head Early.
F—Copenhagen Market.
G—Golden Acre.
H—Enkhuizen Glory.

After putting the field in excellent condition for planting, it was converted into 32 equal-sized beds, 1.1 m. by 10 m. with a path of 30 cm. Including this corresponding path or ditch, the area of each bed or plot was 14 sq. m. As all these 32 beds were in one column, the varieties were planted consecutively for every set of variables as listed above until the four replications were completed.

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[1] Annual Report of the Director of Plant Industry, 1936, page 75.

Holes were made 50 cm. apart each way, in triangles, allowing 38 plants per bed. Into each hole a shovelful of compost and 50 grams of station fertilizer mixture No. 3 with the proximate composition of 10 N—15 P205—10 K20 were mixed thoroughly with the loose earth in each hole.

On January 4–5, 1937, all the eight varieties were transplanted in the 32 beds. For the four replications there were 152 plants per variety.

Treatments, such as spraying at regular weekly intervals with the standard Imazu-lead arsenate-soap solution, cultivation, weeding, and watering by running water in the canals, were done uniformly for the 32 beds.

The dates of the maturity of the first and last head of each variety were noted and given hereunder:

A–Succession: April 16 to May 31.
B–Premium Flat Dutch: April 24 to May 31.
C–Large Charleston Wakefield: March 17 to May 3.
D–Improved All Head Select: March 23 to May 31.
E–All Head Early: March 21 to May 15.
F–Copenhagen Market: March 17 to May 15.
G–Golden Acre: March 17 to May 1.
H–Enkhuizen Glory: March 30 to May 31.

Results.—The results of the harvests are consolidated and presented in the following table:

TABLE 3.—*Second series of variety test results with cabbage, showing total number of plants heading and marketable and yield of four replications, average yield per bed in kilos, average weight per head in grams, per cent headed, and calculated yields per hectare.*

	A—Succession			B—Premium Flat Dutch			C—Large Charleston Wakefield			D—Improved All Head Select		
	Plot	Headed	Yield	Plot	Headed	Yield	Plot	Headed	Yield	Plot	Headed	Yield
	1A	4	1.60	2B	6	3.60	3C	1	0.96	4D	7	7.00
	9A	15	6.26	10B	19	8.68	11C	18	12.18	12D	30	20.18
	17A	27	17.58	18B	15	14.94	19C	25	14.94	20D	11	5.76
	25A	14	12.10	26B	21	15.90	27C	20	13.65	28D	26	21.30
		60	37.54		61	43.12		64	41.73		74	54.24
Average per bed		9.385+2.29			10.78+1.95			10.43+2.16			13.56+2.83	
Average weight per head in grams [1]		583			685			678			754	
Per cent headed		39.47			40.13			42.10			48.69	
Calculated yield per hectare in kilos		6,700.9			7,696.9			7,447.0			9,681.8	

	E—All Head Early			F—Copenhagen Market			G—Golden Acre			H—Enkhuizen Glory		
	5E	20	14.90	6F	7	2.80	7G	17	7.54	8H	18	8.96
	13E	38	20.82	14F	26	15.70	15G	12	10.20	16H	15	11.80
	21E	26	21.20	22F	1	0.60	23G	20	10.70	25H	36	26.70
	29E	24	24.12	30F	15	6.96	31G	19	16.60	32H	27	22.18
		108	81.04		49	26.06		68	45.04		96	69.64
Average per bed		20.26+1.28			6.515+2.23			11.26+1.28			17.41+3.10	
Average weight per head in grams		557			516			662			711	
Per cent headed		71.09			32.37			51.32			62.50	
Calculated yield per hectare in kilos		14,465.1			4,851.7			8,039.6			12,430.7	

[1] Calculated per replication, instead of total results of each variable.

Summary 1.—During the 1936–37 regular season, a second series of cabbage variety tests, consisting of eight varieties, was conducted at Baguio.

2. With the eight varieties studied, the order of yield was as follows: E–All Head Early, H–Enkhuizen Glory, D–Improved All Head Select, G–Golden Acre, B–Premium Flat Dutch, A–Succession, and F–Copenhagen Market. The first three varieties, All Head Early, Enkhuizen Glory, and Improved All Head Select were outstanding in yield.

3. In weight of head, the eight varieties stood in the order named: D–Improved All Head Select, H–Enkhuizen Glory, B–Premium Flat Dutch, C–Large Charleston Wakefield, G–Golden Acre, A–Succession, E–All Head Early, and F–Copenhagen Market.

4. In percentage of heading and marketable heads, the varieties were in the following order: E–All Head Early, H–Enkhuizen Glory, G–Golden Acre, D–Improved All Head Select, C–Large Charleston Wakefield, B–Premium Flat Dutch, A–Succession, and F–Copenhagen Market.

5. It is to be noted that the order of yield per hectare follows very closely the order of the percentage of heading. In other words, a given variety of cabbage, other conditions being equal, with a large percentage of heading, showing high adaptability to local conditions, is a fair criterion of yield.

IV. CABBAGE FERTILIZER EXPERIMENT, 1936–37 SEASON

Baguio soil is very poor. In order to get a decent crop especially of vegetables, truck gardeners have to resort to heavy fertilization. Representative of this heavy manuring, the fertilizer practice of Trinidad Agricultural High School is quoted: [1]

> "In each hole 40 grams of Corona Especial (5 N– 8P205 –10 K20) 200 grams of ashes, 400 grams of well rotted manure or compost, 50 grams of fish meal and 50 grams of bean meal should be applied before planting. If fish meal and bean meal are not available the Corona Especial should be increased to 60 grams.
>
> "Two weeks after the seedlings are planted into the field ammonium sulphate is applied to each hill once a week either in solid form or liquid. If it is the solid form 5 to 10 grams of ammonium sulphate is dropped near the base of each plant and watered after application. The application should be continued for ten weeks for medium and early varieties and twelve weeks for late varieties."

[1] Vibar, H. N. and Llabres, M. Cabbage Growing in the Trinidad Agricultural High School, Agri. Life 111 (Nov. 1936) No. 11.

As this station uses chemical fertilizers, it is necessary to find the best and most profitable commercial fertilizer for cabbage—our second most important crop.

This paper presents the preliminary results of fertilizer experiment carried out during the regular cabbage season of 1936–37.

Materials and methods.—The land used for this experiment is low and of silty loam. The layout of the 32 beds, their number, their size (1.1 m. by 10 m. with 30 cm. path), the number of plants per bed (38) or 152 plants for the four replications, and the date of sowing the seeds (Nov. 12, 1936) were similar to the previous tests. The only variations were the use of the Large Charleston Wakefield variety only and the fertilizer treatments. There were eight variables in this experiment replicated four times each. The fertilizer treatments were as follows:

A—Ammophos plus sulphate of potash (20 N–20P205–8K20)
B—Ammophos (20N–20P205–0K20)
C—Leunaphos No. 2 plus sulphate of potash (16.5N–20P205–8K20)
D—Station Mixture No. 1 (10N–15P205–8K20)
E—Station Mixture No. 2 (10N–8P205–6K20)
F—Station Mixture No. 3 (10N–15P205–10K20)
G—Fertilica (10N–10P205–24K20)
H—Check (No fertilizer)

Holes 50 cm apart each, in triangles, were dug in each bed. Into each hole a shovelful of compost and 50 grams of the corresponding fertilizer were placed and both mixed thoroughly with the loose earth. The fertilizers were applied at the rate of one and one-fourth ton per hectare. For obvious reasons, the beds were not dressed with ammonium sulphate.

Seedlings of Large Charleston Wakefield were transplanted in January 5–6, 1937.

With the exception of the different fertilizer treatments, all the different field operations, such as spraying with the standard Imazu-lead arsenate-soap solution, weeding, cultivation, watering by canal irrigation were uniform for all the 32 beds.

Observations.—There were noted differences in the various treatments in the development of the plants, the size of plants, the heading propensity, brought about by the reaction of the plants to the specific fertilizers used.

There was a patent variation in heading. The replicated plots of Fertilica, Ammophos plus sulphate of potash, Leunaphos No. 2 plus sulphate of potash, and the station fertilizer mixture No. 1 produced more heads of cabbage than the other treatments.

There were also differences noted among the different fertilizer treatments with respect to the maturity of the cabbage. The earliest harvest was obtained on March 22, 1937, from the C–Leunaphos No. 2 plus sulphate of potash beds, followed by the G–Fertilica plots, the A–Ammophos plus sulphate of potash beds, the B–Ammophos, the F–station mixture No. 3, the D–station mixture No. 1, and E–mixture No. 2 in succession. The unfertilized or check plots yielded the latest, over a month after the first beds produced matured heads.

From ocular observations, the size of the heads of the different treatments varied. The check plots produced the smallest heads.

Results.—Harvest of the different replicated beds was done by primming. The first harvest was made on March 22 and ended for all the experiment on June 26, 1937. The results of the tests are consolidated on the following table:

TABLE 4.—*Fertilizer experiment results with cabbage showing number of marketable heads and quantity in kilos produced per bed, average yield per bed, average weight in grams per head, per cent headed calculated yield per hectare in each treatment, value thereof, expense per hectare and gain or loss for each fertilizer treatment.*

	A—Ammophos plus sulphate of potash			B—Ammophos			C—Leunaphos No. 2 plus sulphate of potash			D—Station fertilizer mixture No. 1		
	Plot	Headed	Yield	Plot	Headed	Yield	Plot	Headed	Yield	Plot	Headed	Yield
	1A	32	20.40	2B	29	20.50	3C	30	18.88	4D	16	12.68
	9A	31	23.00	10B	24	18.20	11C	20	17.16	12D	31	28.30
	17A	27	20.46	18B	23	16.18	19C	26	19.86	20D	35	24.08
	25A	27	17.64	26B	18	10.62	27C	28	17.68	28D	16	9.70
		117	81.50		94	65.50		104	73.58		98	74.76
Average per bed		20,375+0.67			16.375+1.42			18.395+0.42			18.69+3.04	
Average weight per head in grams [1]		697			640			721			709	
Per cent headed and marketable		76.98			61.99			68.42			64.78	
Calculated yield per hectare in kilos		14,547.7			11,691.7			13,134.0			13,344.7	
Value at ₱0.10 per kilo		₱1,454.77			₱1,169.17			₱1,313.40			₱1,334.47	
Estimate expenses per hectare		₱874.56			₱872.65			₱879.80			₱779.31	
Gain or loss per hectare		₱580.21			₱296.52			₱433.60			₱555.16	

TABLE 4.—*Fertilizer experiment results with cabbage showing number of marketable heads and quantity in kilos produced per bed, average yield per bed, average weight in grams per head, per cent headed calculated yield per hectare in each treatment, value thereof, expenses per hectare and gain or loss for each fertilizer treatment*—Continued.

	E—Station fertilizer mixture No. 2			F—Station fertilizer mixture No. 3			G—Fertilica			H—Check (No fertilizer)		
	5E	25	21.61	6F	26	15.26	7G	27	19.24	8H	24	11.60
	13E	23	16.16	14F	17	12.00	15G	23	18.90	16H	26	8.56
	21E	23	14.80	22F	30	21.56	23G	32	29.64	24H	12	4.10
	29E	20	10.88	30F	19	12.00	31G	25	20.50	32H	2	0.34
		91	63.45		92	60.82		107	88.28		64	24.60
Average per bed		15.863+1.48			15.205+1.62			22.07+1.42			6.15+1.61	
Average weight per head in grams [1]		688			660			819			330	
Per cent headed and marketable		59.87			60.54			70.26			42.10	
Calculated yield per hectare in kilos		11,326.2			10,856.4			15,757.9			4,391.1	
Value at ₱0.10 per kilos		₱1,132.62			₱1,085.64			₱1,575.79			₱432.11	
Estimate expenses per hectare		774.12			₱791.71			₱829.90			₱647.69	
Gain or loss per hectare		₱358.60			₱293.93			₱745.89			₱208.58	

[1] Calculated per replication, instead of total results of variable.

It may be illuminating to compare the relative yield in percentage of the different fertilizer treatments to the unfertilized (check) beds, as follows:

A—Ammophos plus sulphate of potash	330
B—Ammophos	266
C—Leunaphos No. 2 plus sulphate of potash	298
D—Station fertilizer mixture No. 1	304
E—Station fertilizer mixture No. 2	258
F—Station fertilizer mixture No. 3	247
G—Fertilica	359
H—Check (No fertilizer)	100

SUMMARY

1. A fertilizer experiment on cabbage comparing seven commercial fertilizers was conducted in the regular season of 1936–37 at Baguio.

2. In the average yield per bed and the calculated yield per hectare, the fertilizer treatments stood in the following order: G—Fertilica, A—Ammophos plus sulphate of potash, D—Station mixture No. 1, C—Leunaphos No. 2 plus sulphate of potash, B—Ammophos, E—Station mixture No. 2, E—Station mixture No. 3, and check. The first four fertilizers named gave remarkable results.

3. In percentage of heading and marketable cabbage, the treatments were in the following order: A—Ammophos plus sulphate of potash, G—Fertilica, C—Leunaphos No. 2 plus sulphate of potash, D—Station mixture No. 1, B—Ammophos, F—Station mixture No. 3, E—Station mixture No. 2, and check.

4. There was variation in the average weight per head in the different fertilizer treatments, even if within the same variety. As a rule, the more favorable the fertilizer, the larger heads were produced.

5. In the most important fact sought, namely, the profit to be derived by the use of specific fertilizer, the different treatments come in the following order with the corresponding profit stated after each:

G—Fertilica	₱745.89
A—Ammophos plus sulphate of potash	580.21
D—Station fertilizer mixture No. 1	555.16
C—Leunaphos No. 2 plus sulphate of potash	433.60
E—Station fertilizer mixture No.	358.50
B—Ammophos	296.52
F—Station fertilizer mixture No. 3	293.93
H—Check (No fertilizer)	loss–208.58

6. A large loss is sustained by planting cabbage with our soil conditions without the application of some concentrated fertilizer, preferable complete. In spite of less expense of production, the check plot showed a loss of ₱208.36. On the other hand, with the most favorable fertilizer the yield can treble that of unfertilized cabbage.

V. COMPARISON OF THE BED AND BANKING METHODS OF CABBAGE CULTURE

The initial trial.—During the 1935–36 regular cabbage season, a commercial comparison of the bed and banking methods of culture was first tried at this station. Due to the facts that the different cultural plots were not intercalated, following the approved fashion for running replicated plots, using the *plant* only as a basis of comparison instead of the *mean yields of the plots*, and the use of another variety, the Early Market, this initial trial is not considered a part of the experiment of 1936–37, which will be described in detail in the following pages. However, a review of this first trial is interesting as it gave remarkable results, a precursor of the following experiment, and as the only reference on this new subject, justifying the need of conducting it on a regular experimental basis.

TABLE 5.—*Showing in parallel lines the 1935–36 comparative results of the bed and banking methods of cultures of the variety Early Market.*

Criteria	A—Bed culture	B—Banked culture	Difference in favor of A
Total number of plants studied	732	732	
Total number of plants headed	658	680	22
Per cent failed to head including unmarketable heads	10.11	7.10	3.01
Total weight of produce in kilos	742.0	833.2	91.2
Average weight of heads in grams	1,128	1.225	97
Calculated yield per hectare minus percentage not heading and unmarketable	25,146.5	28,222.7	3,076.2
Value at ₱0.08 per kilo	₱2,011.72	₱2,257.82	₱246.10
Estimate experiment per hectare on experiment basis	1,048.38	1,138.79	₱90.41
Profit per hectare	₱963.34	₱1,119.03	₱155.69

The results as shown by the above table convincingly show the superiority of the banked over the ordinary bed culture in practically all the criteria, with the only exception of the slightly larger expense of production.

Of paramount importance is the average weight per head, the basis of the tests, giving 1,225 grams in the banked method against 1,128 grams for the ordinary bed method or a difference of 97 grams in favor of the banked method.

The net profit in the banked method of ₱1,119.03 was higher by ₱155.69 than the net profit of ₱963.34 from the bed method of culture. This difference of ₱155.69 in net profit makes the results of the banked culture very remarkable indeed!

The 1936–37 season experiment.—The present experiment comparing again these two methods was undertaken during the 1936–37 regular cabbage season.

Materials and methods.—Seeds of the newly imported variety, the Autumn King, were sown on November 12, 1936 and later pricked in open beds. The ground was converted into 10 equal sized plots with an area of 43 sq. m. each. Each plot could accommodate two beds, 1.1 m. by 15.3 m. with a 30 cm. path between them. The two variables with 5 replications each under comparison were:

A—Bedded plots
B—Banked plots

Since there was only one column of plots, they were laid in succession as follows:

The 5 A plots for the bed system were made into two beds each; on the other hand, the five B plots for the banked method were first planted flat.

Holes in triangles 50 cm. apart each way were due for setting the cabbage seedlings. In the plots for the banking method, the same layout and spacings as the bed method were maintained for setting the plants, in order to allow for the banking. Into each hole a shovelful of compost and 50 grams of the station fertilizer mixture No. 1 (10 N–15 P205–8 K20) were mixed thoroughly with the loose earth of each hole.

All the 10 plots were planted on December 26, 1936. Each plot contained 110 plants, or 550 plants for each variable.

On February 18, 1937, both variables A and B were dressed with ammonium sulphate, 5 grams per plant. Thirty days later another dressing of ammonium sulphate at the same rate was made.

Just after the first dressing, on the same day, the B plots were banked. Banking was the essential part of the B plots. When the plants were well established, about two months after transplanting, the part of the ground corresponding to the 30 cm. canals of the bedded plots was broken with the *tjankol* (Malayan hoe) and placed level on the banked bed, thus two banked beds were formed in each B plot. Part of the stem and the lowermost leaves of the cabbage, including the growth of weeds, mostly grasses, were buried *in situ* by the earth. When thus covered, the small weeds were buried and smothered. After the banking operation, the five A plots and five B plots, having two beds each plot, had the same appearance, with the notable exception that the newly banked beds showed neater and more level appearance with slight growth of weeds than the originally bedded plots. The cabbage plants in the B banked plots were lower with shorter exposed stems than the plants in the A bedded plots. Two banking operations at regular intervals should have been done, but since after the first operation produced the same height as the beds of the A bedded plots, only one banking was considered sufficient.

With the exception of banking, all the other essential field operations such as spraying, weeding, irrigating, and harvesting were similar and were carried out simultaneously in the two variables under comparison.

Results.—Harvests at regular intervals were made by priming the matured heads, beginning on March 23 and closed on June 7, 1937. The results were consolidated and are shown in the following table.

TABLE 6.—*Results of bed and banked cultures of cabbage, showing number of marketable heads, quantity produced per plot, average yield per plot in kilos, average weight in grams per head, per cent headed, calculated yield per hectare and value thereof at ₱0.10 per kilo, expenses per hectare and profit derived from each method of culture.*

	A—Bed Culture			B—Banked Culture		
	Plot No.	Headed	Yield	Plot No.	Headed	Yield
	1A	86	83.78	2B	93	108.80
	3A	70	60.06	4B	75	82.38
	5A	82	101.08	6B	82	93.60
	7A	65	51.90	8B	60	64.58
	9A	45	24.56	10B	51	36.80
		348	321.38		361	386.16
Average yield per plot in kilos		65,276+9.03			77.32+7.08	
Average weight per head in grams [1]		858			1,041	
Per cent headed and marketable		63.3			65.5	
Calculated yield per hectare in kilos		15,180.5			17,981.4	
Value at ₱0.10 per kilo		₱1,518.05			₱1,798.14	
Estimated expenses per hectare		₱804.31			₱889.81	
Profit per hectare		₱713.74			₱908.33	

[1] Calculated per replication, instead of total results of each variable.

TABLE 7.—*Comparative results in parallel lines of the two methods of culture, showing the criteria and the differences in favor of the banked culture.*

Criteria	A—Bed culture	B—Banked culture	Difference in favor of B—Banked culture
Total weight of produce in kilos	321.38	386.16	64.78
Average production per plot in kilos	65.276	77.32	12.044
Average weight per head in grams	858	1,041	183
Per cent headed	63.3	65.5	2.2
Estimated yield per hectare in kilos	15,180.5	17,981.4	2,800.9
Value at ₱0.10 per kilo	₱1,518.05	₱1,798.14	₱280.09
Estimated expenses per hectare	₱804.31	₱889.81	—₱85.50
Profit per hectare	₱713.74	₱908.33	₱19.59

Interpretation of results.—In the comparative results of the two methods as consolidated and graphically shown in Table 7, the banked method of culture was found superior to the bed system of culture, except in the expenses of production. In the combined production of five replicated plots for each variable under comparison, the yield of the B–banked plots–was greater by 64.78 kilos than the yield of the A–bed plots. In the average

production per plot, likewise, the B plots produced 12.044 kilos more than the A plots. On the average taken per replication, the cabbage heads produced in the banked plots were heavier by 183 grams than in the bed plots. Again, there was a slight increase of 2.2 per cent of heads in the B plots over the A plots. When expressed in terms of hectare basis for comparison of possibilities, the banked culture yielded 2,800.9 kilos more of marketable cabbage than the bed culture. In comparing the gross income at ₱0.10 per kilo, the price at which this cabbage was sold, the banked culture produced ₱280.09 more than the bed culture. While in the total expense of production per hectare, the banked culture registered a higher expense of ₱85.50, due to the lack of skill of the laborers in the banking work, yet the net profit in the banked method of culture was ₱194.59 greater than the net profit derived from the bed culture. In the final analysis, this difference of profit is of the greatest importance, justifying the statement that the banked culture for cabbage is superior to the ordinary bed culture.

Summary.—1. Our initial commercial test in the 1935–36 regular cabbage season, comparing the two cultural methods, the banked culture was found superior to bed culture, which fact justified the carrying out of a real experimental study on the subject.

2. In this experiment during the 1936–37 season with five replicated plots, the banked culture was, again, found superior to the bed culture in the greater total production; higher average yield per plot; bigger heads of cabbage; greater percentage of plants heading; larger calculated yield per hectare; greater gross income; and most important of all, overshadowing all other advantages, was the greater net profit of ₱194.59 per hectare in favor of the banked culture.

3. This greater net profit justifies the general use of the banked culture of cabbage by gardeners to supplant the ordinary bed culture in vogue.

COMMERCIAL RAISING OF CABBAGE
(*BRASSICA OLERACEA* L.)

(Farmers' Circular 5)

By ANIANO ELAYDA
Assistant Agronomist

TWO PLATES

Cabbage is one of the most important vegetables in the Philippines and in many respects, the most popular and universally used leafy vegetable. It is a very profitable crop when grown under favorable conditions. It is a crop that is easy to grow, but being comparatively a new crop in the Philippines, there are many points to be known as yet by our farmers.

P. I. PRODUCTION AND IMPORTATION OF CABBAGE

Year	Production			Importation	
	Hectarage planted	Yield (kg.)	Value (Pesos)	Quantity (kg.)	Value (Pesos)
1931	1,541	1,432,020	249,110	1,031,049	191,596
1932	1,469	1,186,270	169,530	888,198	146,441
1933	1,416	1,122,700	161,370	437,025	61,192
1934	1,449	1,147,320	154,900	629,033	101,402
1935	1,682	1,476,890	211,820	650,709	112,592
Average	1,511	1,273,040	189,346	727,183	122,645

Based upon the 1935 figures, our home production would have to be more or less doubled in order to do away with this importation.

VARIETIES

The most outstanding characteristics of the different varieties of cabbage tried under Philippine conditions are as follows:

1. *Early Flat Dutch.*—Early variety with solid, almost round, flat heads averaging 0.34 kilo per head in weight.

2. *Solid South.*—Late variety with big solid, nearly round heads averaging 0.58 kilo per head in weight. It is a good yielder and well adapted to places with a long dry season.

3. *Wood's Extra Early.*—Early variety producing nearly round, solid heads weighing 0.38 kilo per head.

4. *Late Flat Dutch.*—Late variety with big, solid, and almost round heads averaging 0.72 kilo per head in weight. It is one of the best yielders and adapted in warm climate.

5. *Sure Head.*—Late variety with big, solid, nearly round heads averaging 0.61 kilo per head in weight.

6. *Henderson's Early Summer.*—Early variety producing fairly big, nearly round, solid heads averaging 0.52 kilo per head.

7. *Copenhagen Market.*—Early variety, globe-shaped, compact and hard, weighing about 1.5 kilos per head under favorable conditions.

8. *All Seasons.*—Rather late variety, flat, large and hard, typically weighing about 2 kilos per head under favorable conditions.

9. *Early Jersey Wakefield.*—Early variety, compact, heavy conical head, rather small and typically averaging 0.63 kilo per head. It is a fair yielder.

10. *Early Winningstadt.*—Rather early variety, head conical and small to medium, typically weighing about 0.41–1.0 kilo per head. It is a good producer of heads.

In general, certain varieties or types of cabbages differ in size and yield of heads. It has been found that varieties with conical heads are better producers in number of heads than those with round heads, but they do not produce big heads and so are not as good yielders as those with round and flat heads.

The Horticulture Section of the Bureau of Plant Industry has made further studies of varietal test of cabbage under Philippine conditions and among over 30 varieties tested only the Henderson's Succession, Early Flat Dutch, Late Flat Dutch, Allhead Early, Charleston Wakefield, Solid South Sure Head, Henderson's Early Summer and Early Winningstadt have been found to grow well, possessing some special desirable qualities. These varieties, besides found well adapted to our local conditions are also very promising in the industry of growing this crop on a commercial scale.

SOIL AND CLIMATIC REQUIREMENTS

Successful cabbage growing requires a fertile soil with a uniform supply of moisture. This crop grows luxuriantly at high altitudes on account of the mild and favorable climate prevailing therein, but it can also be grown successfully at low altitudes

provided the soil is fertile with an abundant and uniform supply of moisture. It has been shown that this crop can be grown from low altitudes in the Central Luzon provinces up to an altitude of 8,000 feet as in the Mountain Province.

Cabbage is a short season crop, ranging from three to four months. Two to three crops a year could therefore be produced in succession on the same land. The most favorable planting period is during the cool months from October to January, but fairly successful crops could be raised at other periods of the year excepting July, August and September during which months the heaviest rains occur.

Commercial planting under intensive culture are found in Baguio, Benguet, where the climate is favorable. Very light soils usually deficient in organic matter are not suitable for cabbage growing because such soils have very poor moisture holding capacity and the crops suffer severely from lack of water and plant food.

PROPAGATION

For large scale planting of cabbage the propagation of seedlings is very important. Good seeds and vigorous seedlings are necessary requisites for getting a good crop. Every precaution should therefore be taken to avoid producing poor planting materials. Always secure seeds from reliable or reputable seed firms that sell seeds which are pure, free from admixture, uniform and genuine.

Preparation of seed beds.—Cabbage seedlings for large scale planting are raised in propagating beds. Ordinarily, these beds are made 1 to 1.2 meters wide each, and of any desired length, and raised 10 to 15 centimeters above the level of the path. During the periods of uncertain weather, that is, when heavy rains or extremely dry spells are expected to occur, a portable shed ought to be constructed over the bed to protect the tender seedlings from too much rain or excessive head, otherwise, a shed or an awning is not necessary.

The bed must be fairly or moderately rich, friable and mellow in order to have a moderate rate of growth of seedlings. A heavy soil is objectionable in that it is liable to harden and when the seedlings are removed for transplanting under destruction may affect the tender root systems. Likewise, open loose soil should be avoided as it dries up too fast. Extremely rich soil, on the other hand, would tend to produce weak, spin-

dling, soft seedlings unsuitable for transplanting under field conditions especially if the seedlings have not received adequate sunlight.

Sowing of seed.—Before sowing the seed, it is always advisable to take its percentage of germination so as to determine offhand the rate of sowing and the quantity of seed to sow for the desired area. The simplest way to test the percentage of germination is to place 100 seeds between 2 pieces of blotting paper on a glass or clay plate with a cover to fit, and then to keep the paper moist for one week or so. The percentage of germination can be taken by counting the number of seeds that germinated. Before the seed is sown, the beds should be sterilized by pouring boiling water or burning trash over them as a precaution against destructive soil fungi. After the beds have been put in condition, the seed should be broadcasted over the surface as uniformly as possible and then covered lightly with fine soil.

For every hectare, it would require 200 to 300 grams of seed with a germination of about 80 per cent. From 150 to 200 square meters of seed bed are sufficient to accommodate this quantity of seed. Of course, it is always desirable to sow a little extra amount of seed to give ample allowance for destruction by pests, diseases, etc., and for culling undesirable seedlings.

Care of seedlings.—The soil in the seed bed should be kept moist all the time. Weeds should be pulled off whenever they appear. If the seedlings are attacked by "damping off" diseases, all the infected ones including the few healthy seedlings immediately around the infected area should be removed together with the soil, and burned. Treating the infected area with 5 per cent formalin solution will minimize further infection. Crowded portions in the bed should be thinned out and pricked in the less crowded spaces so as to allow ample room for the seedlings to develop.

If the seedlings are grown under shed, the shed should be removed from time to time to harden the plants and about a week before transplanting, the seedlings should be completely exposed to the sun and watering withheld. After a month from the time of sowing, the seedlings ought to be ready for transplanting.

Preparation of land.—The land must be thoroughly plowed, harrowed and the weeds gathered and burned. Two or three

plowings and an equal number of harrowing would be enough to put the land into a state of fine tilth.

Field system of planting.—This system of planting may be appropriately termed the extensive system of growing cabbage in which the use of hand labor in cultivation and weeding is reduced to the minimum. The plants are set in single rows on shallow furrows during the dry season planting and in raised furrows or ridges during the rainy season planting. The ridges are made by plowing in such a way as to throw the earth from both sides toward the center. The newly formed ridges should be about 20 to 25 centimeters high a week or two before transplanting and at the time of transplanting when the earth shall have become firm and settled, about 10 to 15 centimeters. The seedlings should be set on top of the ridge in order to keep the plants above the water-logged soil especially if the soil is heavy and the water after the rains does not drain off readily. This system then would facilitate drainage which is essential during the rainy season planting. The furrows can be made to the desired depth by a proper adjustment of the plow.

The plot or bed system of planting.—This system of planting is resorted to in the intensive system of growing cabbage in which a large amount of hand labor is employed. The beds are made by the plow and afterwards put into proper finish by hand. The beds may be raised 10 to 15 centimeters above the level of the spaces or paths between them. The width of the beds should be large enough to allow double row planting. The plants are set 60 centimeters apart.

Transplanting.—Seedlings are ready for transplanting at the age of about a month. If the seedlings have been grown under shade and are tender, they should be exposed to sunshine to harden. Before pulling them up, the beds should be watered thoroughly to make the soil soft, thereby minimizing the breakage of the roots of the seedlings. Only healthy and vigorous seedlings should be planted. A trowel is a handy tool for making the holes in the furrows or ridges, as the case may be, in which to set the seedlings. In setting the seedlings care should be taken not to bend the roots as improper planting deters normal development. In non-irrigated land, the plants are to be firmly set and the soil lightly pressed against the roots. When irrigation by gravity is to be used, seedlings may be set in each hole with the use of a dibber and the roots covered with soil by hand. The soil is then irrigated by running water

along the furrows. A week later all dead or weak seedlings should be replaced.

Number of seedlings.—By the furrow system of planting in which the furrows are made 70 centimeters apart and the plants are set 60 centimeters apart in the furrows, there will be about 23,000 plants to the hectare. In the bed or double row system of planting, in which the plants are set 60 centimeters apart, there will be 27,500 plants to the hectare. The range of distancing would vary, depending upon the variety to be planted from 60 to 70 centimeters between plants and 70 centimeters to one meter between rows. The rate of transplanting per man-day would depend upon the skill of the planter and the preparation of the land. When the land is properly prepared, one planter can set around 6,000 seedlings a day.

CARE OF THE GROWING CROP

Cultivation.—A knowledge of the character of the root system of cabbage is essential in the proper cultivation of the crop. On well prepared land, cabbage roots penetrate to a depth of about 60 centimeters. Ordinarily, therefore, the root system, when fully developed, extends from the base of the plant which is only a few centimeters below the surface of the soil, to a depth of 60 centimeters. In the early stages of growth, cultivation may be made close to the plants to a depth of about 8 centimeters. But by the time the plants are half-grown, the roots entirely fill the spaces between the rows so that at this stage, cultivating at the same depth, especially if made close to the plants, will destroy many roots. A more shallow cultivation should therefore be made and mulching with a layer of rice straw, grass or leaves around the plants will be necessary. Deep cultivation will prevent root development in the rich surface of the soil.

Cultivation may be done by a toothed cultivator or by a garden hoe.

Manuring and fertilization.—Unless the land has been previously planted to green manure crops and contains sufficient organic matter, it should be dressed with liberal amounts of well rotted animal manure. The application of commercial fertilizers, such as ammonium sulphate and others will not prove very effective if the soil is deficient in organic matter. Before planting, the manure should be mixed thoroughly with the soil.

For economy in the use of fertilizing materials, each hill may be given a shovelful of manure and the commercial fertilizer applied as top dressing. If ammonium sulphate is used, one hectare would require from 350 to 500 kilograms.

The time and manner of applying commercial fertilizer is very important. A uniform and constant supply of quick-acting ones must be made available to the plants throughout their growing period to enable them to head early and produce a heavy crop. A deficiency in the supply of available plant food will retard the growth of the seedlings after transplanting, delay the heading of the plants and correspondingly reduce the yield. Experiences and good judgment are the best guides in determining the best time for applying the fertilizers. It must be considered that too early or too late application would not produce the desired result. After heavy rains, the quantity of readily available fertilizers in the soil is diminished and when not replenished, the plants may exhibit a yellowing of the leaves. Any application of more nitrogenous fertilizer is then necessary. It is believed that 2 to 3 weeks after transplanting the first application should be made and the second application 4 to 6 weeks afterwards. If the application of the fertilizer is made too early, much plant food may be wasted as the seedlings may not be able to use it up readily; if made too late or when the head-forming period is already passed, the application of fertilizers may not only fail to increase the yield but may also influence the production of soft heads.

Fertilizers for top dressing may be applied by hand and afterwards worked into the soil by cultivating it within the reach of the root feeding area.

Irrigation and watering.—Water is one of the principal factors in the success of raising cabbage. The soil should be kept moist but never soaked with water. The moist condition of the soil should be maintained during the active growing period from the time of transplanting.

In irrigating a cabbage field, two essential factors should be considered: (1) To keep the soil well supplied with water, and (2) To cultivate as soon, after irrigation, as the surface of the soil would permit, in order to conserve moisture and prevent cracking and backing. The frequency of applying water must be timed according to the condition of the weather, the water holding capacity of the soil, and the season of planting. When

there is no rain, watering may be needed once a day or in two days. Early planting will save labor in watering. Late planting in December and January may need frequent watering and more so as the dry season advances. After the heads begin to harden watering should be decreased.

Preferably, the water should be run in furrows alongside the plants or in paths between the beds and allowed to seep through the beds. To get an even distribution of water, the rows or furrows should not be made unduly long, especially in very porous soil.

Harvesting and handling.—Experience would guide one as to the proper time of harvesting the crop. The right stage at which to harvest would depend upon the marketing facilities of the variety planted. If intended for the early market and can be disposed of with dispatch, cabbage may be harvested as soon as the heads are big enough even if they have not yet attained the right firmness. If intended for distant shipment, the heads must be allowed to attain the proper firmness before being harvested otherwise, they are liable to get soft and spoiled or otherwise command a very low price. The pointed head varieties may be harvested as soon as the lower portion of the head gets firm; the top portion of the head is naturally less firm than the lower and do not get any harder even if harvesting is delayed. The round and flat varieties should be allowed to become hard when harvested and when the outer head leaves of a fully developed head curl upward and backward over the top of the head and have become distinctly lighter or more yellowish green. Mature cabbage should not be left long in the garden as the head is liable to burst. Bursting can be decreased by not watering the plant when already matured.

The heads should be severed from the plant with a sharp knife so as to include 2 to 4 wrapper leaves graded according to their sizes and then packed in well ventilated bamboo baskets. The heads should not be washed, otherwise rotting would take place.

PESTS AND DISEASES AND THEIR CONTROL

The cabbage crop is subject to the attack of many insects and fungus diseases, so much so that unless adequate and timely remedial measures could be provided, it becomes unprofitable to grow this crop. Since most gardeners and truckers are not familiar with the proper and effective control measures, they become reluctant to grow cabbage in spite of its being a remunerative crop.

There are two very destructive insects of cabbage, the cabbage caterpillar. *Crocidolonia binotalis* Zel. and the Diamond-black moth, *Plutella maculipennis* Curtis.

The cabbage caterpillar is one of the most injurious pests of cabbage. The caterpillars prefer to feed on the young succulent leaves and buds, mutilating or devouring them completely or boring into the heads and feeding inside.

The Diamond-black moth usually lays its eggs on the lower surface of the leaves and the larvae or caterpillars upon hatching feed on the leaves and riddle them with holes. The plants so damaged get stunted and in serious cases may produce no heads.

Spraying with soap solution.—A solution of one-fourth kilo of soft yellow laundry soap (Chinese soap) dissolved in 20 liters (one kerosene canful of water) has been found to kill the caterpillars or larvæ. The spraying should be done in the morning, or late in the afternoon and should be directed to the lower surface of the leaves where the caterpillars usually stay or hide. The spraying should be repeated three to six times whenever necessary.

Spraying with lead arsenate.—Spraying with lead arsenate at the rate of 1.5 to 4 grams per liter of water (30 to 80 grams or 6 to 16 level spoonfuls, for every petroleum canful or about 20 liters of water). Direct the spray especially to the lower surface of the leaves. To make the spray adhere better to the leaves, resin soap sticker at the rate of about 50 cubic centimeters per liter of the spray may be added.

If aphids or plant lice and white flies are present on cabbages, the following combined formula may be used:

Soft yellow soap	⅛ to ½ kilo or 200 to 500 grams.
Lead or calcium arsenate	30 to 80 grams or 6 to 16 spoonfuls, levelful.
Water	20 liters or about one petroleum canful.

The soap is not only deadly to the aphids and white flies but also to the caterpillars if the maximum amount of 500 grams is used. At the same time it serves as a sticker for the lead or calcium arsenate.

Collecting the eggs, larvae, and pupae and killing them will help reduce the damage.

Following are some of these diseases and their control:

1. *Club Root* (*Plamsodiophora brassicae. Wor.*)—Affected plants show a wilting of the foliage in the day, although re-

covering in the evening or during cloudy weather. Diseased plants are dwarfed, pale and sickly in appearance. The disease is more severe on seedlings whence it is carried to the field. The disease is caused by slimy mold.

The disease is controlled by liming the soil to minimize its effect by practising crop rotation, and by planting resistant varieties.

2. *Black rot* (*Pseudomonas campestris,* Pommel).—This disease is also known as stem rot. The symptoms are burned appearance of the margin of the leaves and yellowish of all the affected parts, except the veins, which remain blackened. The disease spreads from the leaves to the stems. It works in the fibro-vascular bundles of the leaves and main stalk, causing a premature defoliation. Plants seriously affected very often do not form heads.

To control the disease, the seeds before planting should be disinfected for 15 minutes in a solution of $\frac{1}{4}$ pint (0.473 liters) of pure (40 per cent) formaldehyde diluted in 7 gallons of water. Avoid the use of disease-infected manure in the seed bed and before sowing immerse the seeds in 1–1,000 solution of corrosive sublimate for 30 minutes rinse with clean water, and then dry. Practice crop rotation.

3. *Soft rot* (*Bacillus carotovorus, Jones*)—This disease causes trouble both in the field and in storage. The disease is characterized by soft, mushy to slimy decay of the entire plant. The disease works rapidly under favorable moisture and temperature conditions gaining entrance through a wound or bruise.

Proper ventilation of storage room, proper drying of cabbage by exposure to sunlight, and crop rotation in the disease fields are the methods of control.

4. *Damping off* (*Olpidium brassicae, Worr. Dang.*)—Seedlings are attacked in seed beds. Infected seedlings are soft and water-soaked at the base of the stem and when pulled break off easily.

Soil disinfection, proper shading and thin sowing of seeds in the beds will check or minimize the disease.

5. *Downy Mildew* (*Peronospora parasitica* (Pers.) *De By*)—This is a field disease causing considerable damage to young seedlings. It is characterized by whitish downy patches on the under side of the leaf. The infected areas are angular, pale yellow and somewhat shrunken.

To control the disease, the plants in the seed bed or in the field should be sprayed with 4-4-50 Bordeaux.

5. *Drop* (*Sclerotinia libertiana* Fckl.)—The trouble may be recognized by dropping and wilting of the leaves. On examining a dead plant, a white cottony fungus growth is found on the underside of the lower leaves, and near the moist regions at the stem end.

Plants which show indications of disease should be pulled out and burned and the place where it grew drenched with a solution of one pound of blue stone dissolved in seven gallons of water.

7. *Black leg or foot rot* (*Phoma oloracea* Sacc.)—The disease is usually manifested in the seed bed about two to three weeks before transplanting in the field. Infected seedlings usually collapse and take on a bluish color. In the field, the foliage of the older but affected plants usually take on a mottled, metallic, bluish-red color at the margins and the lower outer leaves wilt. On examining such plants there will always be found sunken lesions which often girdle the foot of the plant.

To control the disease, treat the seed bed with 4-4-50 Bordeaux, applied immediately after planting, at the rate of one gallon to each 10 square feet of bed space. The bed should again be sprayed with Bordeaux about two weeks before and once again at transplanting. Also treat the seeds as recommended under Black Rot disease.

8. *Black mold* [*Alternaria brassicae* (Berk.) Saac.]—This is a serious disease of cabbage. Affected leaves are covered with spots which are nearly black on the underside of the leaf. The spots are composed of a series of rings, the smaller ones enclosed within the larger. There is no distinct border separating the diseased from the healthy, the spots gradually shading off into the healthy tissue.

It may be checked by spraying with 4-4-50 Bordeaux mixture.

9. *Leaf spot* (*Cercospora bloxami* B. and Br.)—This is a disease of little importance.

10. *Wilt or yellows* (*Fusarium Conglutinan* Wall.)—This disease is so economically important that cabbage growers lose so heavily from wilt and in other cases has made cabbage growing very unprofitable.

Affected seedlings are yellowish and stunted in growth with a tendency to drop their lower leaves at the least touch. Such plants when planted in the field either die outright or make very slow growth. The symptoms in the older plants are the same as in the young plants. The outer leaves turn yellow

and drop off one by one until only the bare stump and top head are left. Under field conditions, high temperatures are very favorable for the spread and development of the disease.

Cabbage yellows can not be readily controlled. Naturally a clean seed bed should be chosen but even healthy seedlings when transplanted into infected fields will soon contract the disease. The same also holds true even when the seeds are disinfected. Neither is crop rotation a sure method of control. The best method of control is the development of resistant varieties.

11. *Root knot* [*Heterodera radicicola* (Greef.) Mull]—This disease is most prevalent in light soils. With proper culture and fertilization, however, a crop may be produced with practically very little loss. The disease is characterized by a swelling on the roots, showing itself in small knots formed either singly or in pairs, or in strings, giving the affected roots a beaded appearance.

ECONOMICS OF CABBAGE PRODUCTION

Estimate of cost of production by the field or double method of culture (not including land tax and interest on investment and depreciation) on a hectare of land.

Items of operation	Man days	Animal days	Approximate cost (pesos)
1. Cost of seeds, 200 grams			₱4.50
2. Cost of fertilizers, ammonium Sulphate at 500 kilos per hectare			40.00
3. Cost of seed bed preparation	3	½	2.90
4. Cost of raising seedlings which takes a month	8		4.80
5. Cost of preparing land:			
(*a*) First plowing	3	3	3.30
(*b*) First harrowing	½	½	.55
(*c*) Second plowing	3	3	3.30
(*d*) Second harrowing	½	½	.55
(*e*) Third plowing, making beds	5	5	3.30
(*f*) Pulverizing soil and fixing beds	5	5	3.00
(*g*) Preparing and manuring the hills for planting	10		6.00
6. Cost of stable manure or humus			30.00
7. Cost of planting	38		22.80
8. Cost of cultivation and weeding, 4 times	100		60.75
9. Cost of spraying, 6 times	27		16.20
10. Cost of dressing with fertilizers, 2 times	20		12.00
11. Cost of watering by hand	280		168.00
Cost of watering by gravity	8		
12. Cost of harvesting	28		20.80
13. Cost of crates and packing (20 centavos per crate)			100.00
14. Cost of insecticides			28.40
Total			531.15

Planting at a distance of 60 centimeters between plants in double rows, one hectare will accommodate around 27,500 plant hills and this number is reckoned to produce an estimated yield of 25,000 kilos. Based on the average yearly (1931–1935) importation, the value per kilo is approximately ₱0.19. Even estimating at ₱0.10 per kilo, the gross income per hectare reaches over ₱2,500, leaving a considerable margin of profit over the cost of production.

It has been found in Trinidad Valley, Benguet, that it costs ₱0.08 to produce a head of cabbage. In round number the cost of production per hectare fluctuates around ₱1,600 covering cost of fertilizers, control of pests and diseases and all other operations from the preparation of land to the marketing of the product. The production per hectare very rarely falls below the estimated production given above, so that net profit per hectare amounts to ₱900 or more. The raising of cabbage by truckers in the Trinidad Valley is done under very intensive methods of culture, but it is believed a substantial reduction of labor in cultivation and of the quantity of fertilizers applied, would not very materially affect the corresponding yield.

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ILLUSTRATIONS

PLATE 1

(*a*) Newly planted cabbage
(*b*) Two weeks old cabbage

PLATE 2

Two promising varieties of cabbage
(*a*) Charleston Wakefield
(*b*) Succession

PLATE 1.

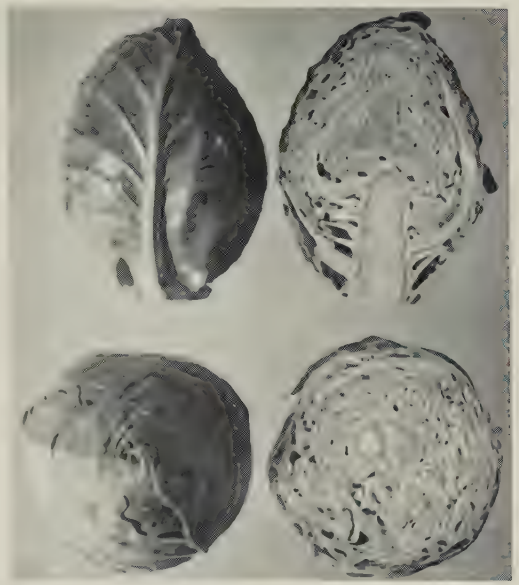

PLATE 2.

COTTON GROWING IN THE PHILIPPINES

(Farmers' Circular 10, Revised)

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FOUR PLATES

The development of the cotton industry in the Philippines is presently being encouraged by the Government in line with the program of crop diversification aimed at stabilizing Philippine agriculture. That cotton is well adapted to many regions in the Philippines is already beyond question. As a matter of fact, since the Spanish time and even before that, cotton has been cultivated in at least two sections of the country, namely, the Ilocano regions and Batangas. The Philippines is a great importer of cotton textile products amounting to over thirty million pesos annually. Japan needs at present big quantities of raw cotton materials to supply her highly developed and extensive textile manufacturing industries. The present local demand for raw cotton in the Philippines is for one local mill only so that the increase in local demand will depend upon the establishment of more manufacturing industries utilizing the raw material.

The fact that Japan is actually a great market and the Philippines a potential one makes it doubly sure that if cotton could be produced in the Philippines in great quantities and the cost of production is low enough to enable it to compete with cotton from other countries in the world's market, the Filipino farmers will find in cotton one of the important crops.

Philippine Islands importation of cotton and its manufactures

Year	Value
1931	₱32,802,095
1932	33,523,243
1933	26,263,250
1934	31,242,920
1935	30,599,841
1936	30,535,257

The values of our annual importation of "knitted cotton", thread and yarns during the years 1931, 1932, 1933, 1934, 1935, and 1936 are as follows:

Year	Knitted cotton in the piece	Thread	Yarns
1931	₱308,381	₱1,984,900	₱1,177,255
1932	242,660	1,782,161	1,028,557
1933	328,236	1,514,718	866,658
1934	430,945	1,750,486	1,094,156
1935	315,367	1,817,482	1,015,173
1936	437,515	2,028,436	1,486,923

The above statistics plainly and conclusively show the importance of developing the cotton industry here.

VARIETIES

There are several species and numerous commercial cotton varieties in the world. In the Philippines, a number of commercial varieties of cotton has been tried; so far none of the newly introduced varieties has proved any better than the two naturalized varieties, the "Batangas White" and "Kapas Purao." These naturalized varieties may be described briefly as follows:

Batangas White.—Upright habit of growth; less resistant to heat and drought; age at blooming time, 84 days; percentage of ginning, 31 per cent; staple length, $1\frac{1}{16}$ to $1\frac{1}{8}$ inches; and yield of lint per hectare, 3.3 piculs.

"Kapas Purao."—The lateral primary branches have the tendency to lodge on the ground; age at blooming time, 78 days; percentage of ginning, 29 per cent; staple length, $1\frac{5}{6}$ to 1 inch; and yield of lint per hectare, 2.5 piculs.

SOIL AND CLIMATIC REQUIREMENTS

Soil.—While cotton is adapted to a wide range of soil types, too sandy and too heavy soils should be avoided. Light sandy to light clay loam are best types of soil for cotton. Soils suitable for the growing of corn, peanut and sugar cane are also good for cotton. A newly opened land gives usually a good crop.

Climate.—A tropical and moist climate is very essential for growing cotton successfully. During the sowing and seedling stage, light and frequent showers are beneficial. Excessive soil moisture is conducive to seed rotting and damping off of

seedings and later on, in the plant's development, it promotes excessive vegetative growth at the expense of boll production. A spell of dry weather which occurs at a later period causes the plant to be stunted, to mature early and, consequently, reduces the yield. Long drought causes it to wilt and hastens the shedding of the bolls and leaves.

An evenly distributed rainfall throughout the growing season alternating with several days of bright and warm weather is favorable to plant's growth. During the flowering period, the plant needs plenty of sunshine. As the crop matures and the bolls start to open, less moisture is necessary as wet weather retards crop development, interferes later with harvesting, and damages the lint in the open bolls. A sunny dry weather for the harvest season of at least three months is essential so that the picking of the bolls is easier, the crops produced are free from mold, and possess luster and white color.

The Weather Bureau classifies climate in the Philippines into four types as follows:

> First type.—Two pronounced seasons: dry in winter (December, January and February) and spring (March, April and May); wet in summer (June, July, and August) and autumn (September, October, and November).
>
> Second type.—No dry season; with a very pronounced maximum rainfall in winter (December, January, and February).
>
> Third or intermediate A type.—No very pronounced maximum rain period; with a short dry season lasting only from one to three months.
>
> Fourth or intermediate B type.—No very pronounced maximum period and no dry season.

Based on the climatic requirements of cotton, the regions falling under the second and fourth types of climate are generally not suitable for this crop. However, big quantities of cotton have been produced in Agusan, Bohol and Lanao. Agusan has produced alternately two crops of cotton due to the favorable climate existing in two distinct regions of the province.

Geographical distribution of cotton growing regions.—The adaptability of cotton in Batangas and the Ilocos provinces is already a known fact. The other provinces where cotton has been tried with success are the following:

Provinces having the first type of climate: Antique, Cavite, Iloilo, Mindoro, Occidental Negros and Pangasinan. Cotton has been found less suited in Central Luzon because of the

peculiar climatic conditions (hot and dry atmosphere), prevailing which were found unfavorable to the flowering and bolling stages of the plant.

Provinces having the third type of climate: Cagayan, Capiz, Cebu, Oriental Misamis, Occidental Misamis, Oriental Negros and Eastern Palawan.

Experience has shown that the success or failure of a cotton crop is conditioned upon the occurrence or non-occurrence of uncontrollable factors, namely, typhoons, drought, etc. The same factors also hold true with any other crops here or elsewhere.

CULTURE

Soil preparation.—The land for the planting of cotton should be prepared at the beginning of the dry season. The land is plowed and harrowed 2 to 3 times in the manner as preparing it for such crops as corn, peanut and tobacco.

Methods of planting.—There are two methods of planting, namely, (1) the ridge and (2) the furrow or "list." The ridge method is used when the planting is done quite early and there is the possibility that the water supply in the soil, especially if the drainage is poor, might go beyond the optimum needed and affect the seeds or young seedlings. The seeds should be sown on top of the ridge in order to keep the seeds above the water logged soil, especially if the soil is heavy and the water after the rains does not drain off readily. This system facilitates drainage which is essential during early planting.

The furrow or the "list" method of planting is used when the soil has the proper moisture content.

Time of planting.—Success in the growing of cotton in the Philippines depends largely upon the proper time of planting. Planting should not be too early or too late although it varies according to the locality. If cotton is planted too early as in August or the early part of September when the soil is still very moist, the tendency is for the seeds to rot or, if the seeds ever grow, the seedlings are weak and very susceptible to damping off. Hard rains accompanied by typhoons and floods often occur during these months which are very destructive to cotton planting.

On the other hand if cotton is planted as late as December the plants become stunted in growth due to insufficient soil moisture and high temperature that usually prevail during the months of January and February when the cotton plants

are still in the active growing stage. Planting as late as December is only advisable in some regions where the atmosphere is humid and there is adequate soil moisture as in Northern Mindanao and on the highlands of Batangas and Cavite. But the fundamental principle to be observed in all cases is to time the planting so as to bring the plants to maturity not later than the middle of the dry season.

The "Batangas White," being a late-maturing variety, should be planted from October to November and the "Kapas Purao," from November to December. The best time to plant the "Batangas White" is during the middle of October, and "Kapas Purao," during November.

Planting.—The distance at which cotton is planted varies according to the fertility of the soil. In soils of medium fertility the distance of planting should be closer than in rich soils. The furrows may be spaced 70 to 100 cm. and the hills in the furrows 50 to 80 cm. apart.

The quantity of cotton seeds to plant in a hectare depends upon the percentage of germination. On the basis of 80 per cent germination, 8 kilos of seeds would be enough for every hectare with sufficient allowance for destruction and for the removal of undesirable seedlings later. In Northern Mindanao where the plantings are made in wider spaces due to soil fertility and where the weather is very favorable to seed germination, 3 to 5 kilos of seeds are enough to plant in one hectare. Three to five seeds are planted to a hill in the same way as planting corn. The seeds germinate in 3 to 5 days from the time of planting. When the seedlings are about 20 centimeters high, the hills should be thinned by pulling off the weak seedlings, leaving only one or two healthy seedlings in each hill.

CULTIVATION

The field should be kept free from weeds. Since the crop is grown toward the dry season, the soil should be kept in good tilth to conserve the soil moisture as much as possible during the active growing period of the cotton plants. The first cultivation should be done about three weeks after planting or when the plants are about 20–25 cm. high. The second cultivation should be done about a month after the first, or when the plants are about to flower. Hoeing and weeding should be done from time to time, if necessary.

HARVESTING

From two to two and one-half months after planting, the cotton plants begin to bloom. Two months later, some of the bolls will mature and will be ready for picking. Picking should be done as soon as the bolls burst open. If picking is delayed after the bolls have opened for sometime, the floss is liable to be blown off by the wind or drop to the ground and get dirty. If picked early enough, the bolls may be immature and the floss obtained are likely to be of poor quality. For well opened bolls, the best way of picking is to remove the floss from the hard carpels.

The cool hours of the day in the early morning or late afternoon is the best time for picking. During the warmest part of the day the coverings or carpels of the bolls are brittle and are liable to be crushed and get mixed with the floss. As the bolls mature at different times, harvesting has to be done several times during the season, at intervals of from two to three weeks. After picking and removing the dirt from the floss, the cotton with seed is dried in the sun and then sorted before placing in sacks. The planters after harvesting their cotton crops usually sell their products with seed.

Some big planters or cotton growers' associations remove the seed before the product is marketed. This is being done by motor-driven ginning machines. The lint thus obtained is then baled at uniform standard weight (small bale-400 lbs.).

If the ginning is done immediately after the harvest, the seed for the next season's planting should be kept in air-tight containers to preserve their vitality and prevent them from getting moldy.

SELECTION OF PLANTS

The primary basis of selecting plants for the production of bolls for seed purposes is the high-yielding ability of the mother plant and its resistance to pests and diseases. The selection of high-yielding, disease-resistant plants should be made when the crop is nearing maturity.

CROP ROTATION

Cotton as a secondary crop to follow rice has been found under certain conditions to be very profitable. In Central Luzon, Zambales, Bataan, etc., where prolonged dry periods exist and where late maturing varieties of rice are planted, cotton does

not fit in as a rotation crop following rice. Based on extensive observations, cotton can be rotated with upland and early maturing lowland varieties of rice which are harvested not later than October. There is a systematic scheme of crop rotation which is beneficial not only to the cotton crop but also to rice. This is rotation with a leguminous cover crop as follows:

From May to the early part of October, the ground is planted to rice. In the second half of October, after the rice harvest, the land is prepared and planted to cotton. After the harvest of cotton, the land, if sufficiently moist, may be sown to any short-season leguminous crop and this plowed under as green manure when the land is prepared for the next rice crop. Should this arrangement be found unworkable under certain conditions, then the next best thing to do is to plant cotton only on one-half of the land after the rice harvest and the other half to legumes, and reversing the order in the following season by planting cotton where the legumes were planted during the last season and vice versa. Such a system will tend to conserve the fertility of the soil.

Sometimes corn is interplanted between cotton plants but this practice is not recommended, since the production of cotton is greatly affected by the intercrop. However, in Batangas this method is oftenly done for obvious reasons.

COTTON PESTS AND THEIR CONTROL

The cotton boll weevil (*Amorphoidea lata* Motsch).—One of the most injurious insect pests of cotton in the Philippines is the cotton boll weevil. As the name indicates, the insect is with a snout or beak at the end of which are the teeth and mandibles and other mouth parts. It is small, dark brown, and about 3 to 4 mm. long. The insects have been observed to gather in the newly opened cotton flowers in the morning, usually between 7 and 10 o'clock. The female punctures the young bolls and lays its eggs in the pistil and the resulting larvæ or grubs eat the young seeds and other soft parts of the seed capsules. The infested squares and bolls usually fall to the ground. As many as five larvæ have been found in a fallen boll. When full grown the larvæ leave the bolls and dig into the soil where they pupate.

Control.—(1) A prompt collection and burning of bolls that fall to the ground to kill the larvæ; (2) the beetles that congregate or gather in the newly opened flowers should be collected and killed; and (3) dusting the beetles in the newly

opened flowers in the morning with 50–50 mixture by volume of calcium arsenate and "gaogao." The bug *Geocoris tricolor* has been found to prey on the beetles and mealy bugs.

The cotton semi-looper or "abutilon moth" (*Cosmophila erosa* Hubn.).—This insect, a measuring caterpillar, has been found quite common on cotton as a leaf-feeder. It is capable of great injury to plants when present in abundance. Besides on cotton, the caterpillars have been observed to feed locally on the leaves of cowpeas. Okra is also one of its hosts. The caterpillars are about a millimeter long and are pale yellow when newly hatched. They soon become light green after feeding and the color becomes more pronounced as they grow older. A full grown caterpillar is about 4 cm. long and 3.5 mm. wide. The adult is brownish yellow, about 1.2 cm. long and with a wing expanse of about 3.8 cm.

Control.—(1) The caterpillars should be promptly dusted or sprayed with either lead or calcium arsenate, preferably the latter as it is cheaper. For dusting, calcium arsenate alone or diluted with "gaogao" may be used. In case of spraying, use from 1.5 to 4 grams of calcium arsenate per liter of water or 7 to 14 spoonfuls (levelful) for every petroleum canful (about 5 gallons) of water. Stir the mixture vigorously before spraying to keep the calcium arsenate particles in uniform suspension. A bucket pump, provided with rubber hose and with a good nozzle that will deliver the spray in fine mist should be employed. A soap solution containing a mixture of from 10 to 20 grams per liter of water ($\frac{1}{5}$ to $\frac{2}{5}$ kilos per one petroleum canful of water) has also been found an effective spray especially on the young caterpillars.

A hymenopterous parasite (*Euplectrus* sp.) has been found to attack the caterpillars. The egg parasite, *Trichogramma minutum* Riley, introduced here from the United States in 1934, has been found to attack the eggs of *Cosmophila erosa*.

The cotton pyralid leaf roller (*Sylepta drogata* Fabr.).—A rather common caterpillar which has been found on cotton is the pyralid moth, *Sylepta derogata*. This insect lays its eggs singly on the underside of the leaves similar to *Cosmophila erosa*. The caterpillar rolls the leaves wherein it feeds and pupates. This habit makes the pest more difficult to control than *Cosmophila*. Like *Cosmophila erosa* the first instar caterpillar feeds on the lower surface of the leaves, leaving the upper

membrane. The adults are yellowish white and measure from 2 to 2.3 cm. across the wings.

Control.—The control measures are the same way as suggested for *Cosmophila erosa.*

The pink bollworm (*Pectinophora Gossypiella* Saund.).—The color of this caterpillar is pink as the name suggests. It is one of the pests which is capable of serious damage when cotton is grown extensively. It has been reported quite destructive in La Union. In other countries, such as Brazil, Egypt and Mexico, it is known to be the worst pest of cotton. The caterpillar is about 1.2 cm. long and 2.5 mm. The adult is about 7 mm. long from the tip of the head to that of the abdomen. It is somewhat dark brown. The moths do not live long. According to records, the great majority of them die in confinement in from 14 to 20 days.

Control.—(1) Early matured bolls which are infested should be gathered and fumigated with either carbon bisulphide or sterilized with heat; (2) all the cotton seeds should be fumigated and stored in tightly closed containers; (3) after the harvest, old plants and fallen bolls should be destroyed.

Some of the other common but less destructive insect pests of cotton are as follows:

The common mealy bug (*Ferrisia virgata* Ckll.).—These insects are very prolific so that in a relatively short time they practically cover the cotton stems, especially so during the dry season. They also attack leaves. Among other hosts, besides cotton, are eggplant, tomato, mango, anona, casoy, cowpea, cabbage, pechay, patola, citrus, guava, etc. Colonies of this mealy bug are attended by several species of ants, among them is the common red ground ant, *Solenopsis geminata.* Spraying with soap solution with a concentration of 10 to 15 grams per liter of water or approximately $\frac{1}{10}$ to $\frac{2}{10}$ of a kilo for every petroleum canful of water is an effective control measure.

The melon aphid (*Aphis gossypii*).—These insects have been observed to attack cotton very early when the plants are about two weeks old. The colonies of the melon aphid present a motley appearance when these insects are crowded together on the underside of the leaves. Adult insects are about a millimeter long or even less. They are also abundant on eggplants, melons, upo, cucumber, pechay, etc. Lady beetles, aphis lion, and certain hymenopeterous parasite (family *Aphelinidae*),

have been found to prey on it. Colonies of this aphid are attended by the red and other ants. The melon aphids are controlled in the same way as the mealy bugs.

Leaf hoppers (*Empoasca flavescens* Fabr.).—One of the most common leaf hoppers on cotton is a small and green insect which is about 3 mm. in length. Like the melon aphids and the common mealy bugs, they become numerous towards the end of the rainy season and cause considerable damage to cotton crop. The female deposits her eggs in the midribs of the cotton plants causing the injured spots to swell. Both the adults and the young are voracious feeders causing the leaves to wrinkle. The other hosts are eggplants and potatoes. The control measure is the same way as that for mealy bugs and aphids.

The cotton stainers "Vacavacahan" (*Dysdercus sp.*).—The pest most common on cotton is *Dysdercus megalopygus*. The general color of the insect is red with black markings on the body. The adult rarely flies, but runs actively. Its long suctorial beak is able to enter the boll and suck out the seeds, causing the seeds to wither and the lint to be stained yellow. There is not much damage done to the plants and its injury to the bolls is not visible until the cotton is picked. The insects have many other host plants preferably the family *Malvaceae* to which cotton belongs. The control measure is to eliminate the alternative hosts, and brushing off the insects into a can of kerosene. Spray with soap solution (same strength as that used for mealy bugs) is also effective.

Other caterpillars.—Besides the larvæ of cotton stem weevil which have been observed to bore into the stems of cotton and causing swellings or gall-like formation thus making the plants stunted in growth, other lepidopterous larvæ such as the corn ear worm *Chloridea* (*Heliothis*) *obsoleta*, cotton leaf miner (*Lithocolletis triarcha* Meyrick) etc., attack the cotton plants by feeding on the leaves, cutting the young seedlings and attacking the bolls. Measures of control are to pick infested parts and burn them, collect and kill the larvæ, or dust with poisons and the employment of egg parasites.

COTTON DISEASES AND THEIR CONTROL

Angular leaf spot or bacterial blight (*Phytomonas malvaceara, Bacterium solanacearum* Erw. Smith).—This disease is caused by a bacterium which enters the plants through the stomata and

through injuries. The organisms attack the seedlings, leaves, bolls, stems and branches of the older plants. The spots on the leaves are watersoaked with yellow borders. The lesion on the stem is designated as black arm and produces a kind of gummosis. The infection on the bolls show circular spots turning brown and later, black. The organisms invade the developing seeds of the bolls and this is considered the most serious phase of the disease since many secondary organisms contribute to the damage. The known control measures are: (1) kill the bacterium on the seeds before planting by delinting the seeds with concentrated sulphuric acid and then treating them in hot water at 72° C. for 18 minutes; (2) infections in the field should be checked by removing the infected parts; (3) all introduced seeds should be grown in an isolated place for observation of diseases, and seeds for planting should be selected from disease-free plants.

Leaf blight (*Helminthosporium gossypii* Tucker).—The disease attacks the most conspicuous parts of the plants such as the leaves, bracts and bolls. The causal organism is a fungus. The disease might have been introduced into the Philippines with imported seeds. Early symptoms can be noted when the plants are 10 to 16 cm. tall. Spots of various sizes and shapes are observed on the leaves. These spots may be circular, zonated and sometimes irregular brown lesions on the margin of the leaves. They may attain considerable sizes especially when two or more of them coalesce forming bigger spots. The lower leaves show more of the disease. In the advance stage of the disease, the spots on the leaves may break off in a shot hole fashion.

The infections on the bolls at first appear as circular spots slightly sunken and dark brown, but later assume irregular shapes of various sizes. The badly diseased leaves fall on the ground and the badly infected plants are stunted in growth. The spread of the disease may be checked in the same manner as the bacterial blight.

Anthracnose (*Glomerella gossypii* Edg.) and (*Collectotrichum gossypii*).—The disease attacks seedlings causing damping off similar to damping off of other seedlings caused by other fungi. The seedlings may die or merely show lesions on the cotyledon. Lesions are also produced on the leaves and stems but serious manifestation of the disease is on the bolls. Brownish sunken

spots surrounded by reddish border are formed on the bolls resulting in the destruction of the bolls. The fungus spores live on the seeds for one year. The disease can be controlled by storing the seeds in dry places for one to two years, by seed disinfection, and by seed selection from disease-free plants.

Sclerotium disease of cotton (*Sclerotium rolfsii* Sacc.).—This disease is considered identical with *S. rolfsii* that attacks abacá, eggplants, lettuce, peanut, soybean and various other plants in the Philippines. It attacks the cotton plant usually on the stem at about the ground level or just below it. The bark in the affected region turns reddish brown, shrinks slightly and finally rots or decays. The rotting develops readily around the stem and then from the base to a few centimeters upwards. It is commonly observed that a cotton plant is completely girdled at the base of the stem. White fungus and sclerotial bodies develop on the surface of the host when there is a high humidity. In severe attacks the infection extends to the woody portion of the stem. The death of the plant at the base is later followed by the wilting of the leaves. Owing to the death of the cells and the gradual weakening of the tissues in the region of infection, the stem breaks and the whole upper portion of the plant topples over. The fungus attacks both seedlings and mature cotton plants; the seedlings are the ones most readily affected especially at the age of from 1 week to 10 weeks. Cotton plants a little over 4 months old seldom get the disease.

The sclerotial bodies of the fungus afford excellent materials for dissemination. The control measures are: (1) the *Sclerotion* disease in seed beds can be greatly minimized by soil sterilization—the soil infected with *Sclerotium* is heated to 100° C for 30 to 60 minutes to completely kill the disease; (2) remove all affected plant parts and burn them immediately; (3) spray with any fungicide like Bordeaux mixtures; (4) the practice of plowing and cultivating to bury the sclerotial bodies about 10 to 15 cm. deep in the soil stops the fungus sclerotia to germinate.

Other various diseases of cotton such as rust (*Kuehneola gossypii*) and Cercospora leaf spots (*Cercospora althaeiana* Sacc.) accompanied by *Alternaria* sp. have been reported but generally do not cause serious damage.

ECONOMICS OF COTTON PRODUCTION

Estimated cost of production of cotton per hectare (excluding land tax and interest on investment)

Field operation	Number of labor days		Approximate value
	Man	Animal	
Cost of seeds (8 kilos at ₱.20 per kilo)			₱1.60
First plowing, ₱1.00 per day	7	7	7.00
First harrowing, ₱1.00 per day	2	2	2.00
Second plowing, ₱1.00 per day	5	5	5.00
Second harrowing, ₱1.00 per day	2	2	2.00
Furrowing, ₱1.00 per day	1	1	1.00
Planting, ₱.40 per day	[1]5		2.00
First cultivation, ₱1.00 per day	2	2	2.00
Second cultivation, ₱1.00 per day	2	2	2.00
Hoeing and weeding, ₱.40 per day	[1]5		2.00
First harvesting: picking, sorting, drying lint and sacking, ₱.40 per day	[1]3		1.20
Second harvesting: picking, etc	[1]3		1.20
Third harvesting: picking, etc	[1]3		1.20
Fourth harvesting: picking, etc	[1]2		0.80
Fifth harvesting: picking, etc	[1]2		0.80
Sixth harvesting: picking, etc	[1]2		0.80
Seventh harvesting: picking, etc	[1]1		0.40
Cost of 10 big abaca sacks at ₱.26 per sack			2.60
Cost of transportation at ₱.20 per sack			2.00
Total expenses			₱37.60

[1] Number of days of woman labor.

Yield per hectare is about 600 kilos of cotton with seed, or 190 kilos of lint.

Price per kilo of cotton with seed	₱0.12
Cost of 600 kilos	72.00
Profit (₱72.00 minus ₱37.60 total expenses)	34.40

YIELD

Under favorable conditions, the normal yield of cotton in the Philippines in regions having a distinct wet and dry periods is from 400 to 500 kilos of cotton floss with seed. In Northern Mindanao where the climate has a dry season of at least three months and during which time the harvest of cotton bolls can be accomplished, very encouraging results have been obtained from the cotton crops. It has been reported that a hectare yields from 500 to 800 kilos of cotton with seed, although in some regions in Oriental Misamis, Agusan and Lanao, a yield of 1,000 kilos of cotton with seed is not uncommon.

MARKETING

The principal factor necessary to stimulate nation-wide interest in going into commercial scale planting of cotton is the presence of markets to absorb raw cotton locally produced. At present there is only one cotton mill working in the Islands with 900-ton capacity, owned by Madrigal & Co., Manila.

The present price of clean cotton floss with seed is ₱0.14 per kilo and that of clean cotton floss without seed is ₱0.45 per kilo, to be delivered at Manila. Better price will induce the planters to plant cotton on their available lands not otherwise planted to other main crops.

One of the Japanese firms, the Mitsui Bussan Kaisha, Ltd., offers ₱0.12 per kilo of clean cotton with seed in the regions where cotton has been raised, particularly in Northern Mindanao.

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ILLUSTRATIONS

PLATE 1

Batangas cotton—one of the varieties grown in the Philippines.

PLATE 2

FIG. 1. Cotton field ready for harvest, Butuan, Agusan.
2. Harvesting cotton, Butuan, Agusan.

PLATE 3

Cotton bolls showing different stages of maturity.

PLATE 4

FIG. 1. Separating the poor cotton out of the good before shipping.
2. Hauling cotton for shipment.

PLATE 1.

PLATE 2.

PLATE 3.

1

2

PLATE 4.

BOOK REVIEW

THE BIOLOGICAL CONTROL OF INSECTS

By HARVEY L. SWEETMAN

[461 pages, 142 figures, 1936. Published by the Comstock Publishing Co., Inc., Ithaca, New York. Price $3.75]

This is undoubtedly the most comprehensive and most useful book written so far on the biological control of insects. There are 14 chapters with a foreword of well deserved appraisal of the book and its author by Dr. L. O. Howard, former chief of the U. S. Bureau of Entomology, himself one of the leading authorities on biological control. The first chapter deals with the theoretical basis of biological control among the topics discussed being biotic potential and environmental resistance with special reference to parasites and predators. The whole of Chapter 2 is devoted to the use of resistant varieties of plants as a means of controlling insect pests. Suggestions are given by which the principles of host resistance may be utilized in plant breeding to produce insect resistant strains. In Chapters 3, 4 and 5 are described the role that bacteria and fungi, viruses and protozoa and parasitic invertebrate animals (nemathelminthes), respectively, play, and the extent to which these may be artificially utilized, in the biological control of insects. The greater portion of Chapters 6, 7 and 8, indeed of the entire book, are chiefly devoted to insect parasites and predators. Chapter 9 deals with some of the biological relations of insect predators and parasites to their hosts. Parasitism and predatism are compared and the different types of parasitism are discussed and illustrations of each type is given.

From a practical standpoint, Chapters 10 and 11 are most helpful. In Chapter 10 the factors which should be considered in the utilization of insect parasites and predators, such as multiple parasitism, hyperparasitism and polyembryony are discussed, together with the sequence theory of parasitism and the time factor in connection with the development and establishment of parasites and predators in a new region where they may be introduced. Chapter 11 deals with the points to

be considered before actual introduction may be attempted, the qualities desired in parasites and predators, methods of handling, shipping, rearing, liberation, etc.

Chapter 12 deals with the use of predatory vertebrate animals, such as toads, birds, mammals, etc. Chapter 13 presents the results of biological control and those that are considered still in the experimental stage are reported and the limitations of biological control are discussed. The biological control of pest plants (weeds) is the subject of the last chapter, Chapter 14, among the cases discussed being those with reference to troublesome cacti, especially in Australia, and Lantana in Hawaii.

The book is provided with a glossary and a long list of references which appears to include the most important works on biological control, and the index appears to be complete in every respect. It is apparent that the author has spared no effort to make the book really useful. It is truly authoritative and complete and constitutes a very handy and most valuable guide and reference to all interested in biology. To economic entomologists, in particular, who should be greatly benefited by it, the book is indispensable.—F. Q. OTANES.

ERRATA

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Page 391, line 3—temperature; *read* temperate.
Page 445, line 8—2.5 to 0.3; *read* 0.25 to 0.3.
Page 445, line 8—6 to 60; read 16 to 60.
Page 457, reference 8—Butoc; *read* Butac.
Page 466, paragraph 4, line 1—derries; *read* derris.
Page 470, paragraph 2, line 2—Shoenobius; *read* Schoenobius.

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2. Lamao Horticultural Station, Limay, Bataan
3. Lipa Coffee-Citrus Station, Lipa, Batangas
4. Tanauan Citrus Station, Tanauan, Batangas
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2. Novaliches Mango Station, Caloocan, Rizal
3. Halcon Rubber Station, Baco, Mindoro
4. Gingoog Lanzon Station, Gingoog, Oriental Misamis
5. Mandaue Seed Farm, Mandaue, Cebu

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